

Looking ahead two weeks to six months

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Kudos to Brad Udall (WWA) & Jeanine Jones for getting me into this mess, Michael Anderson (SC) for data, Jon Eischeid & Klaus Weickmann (NOAA-ESRL) for figures

- Background on CA climate & recent history
- ENSO/PDO: current situation, typical impacts, and outlook
- Official CPC and other precipitation forecasts
- Different factors influencing CA wet season precipitation
- What about the next two weeks?
- “Executive Summary”

Bear in mind

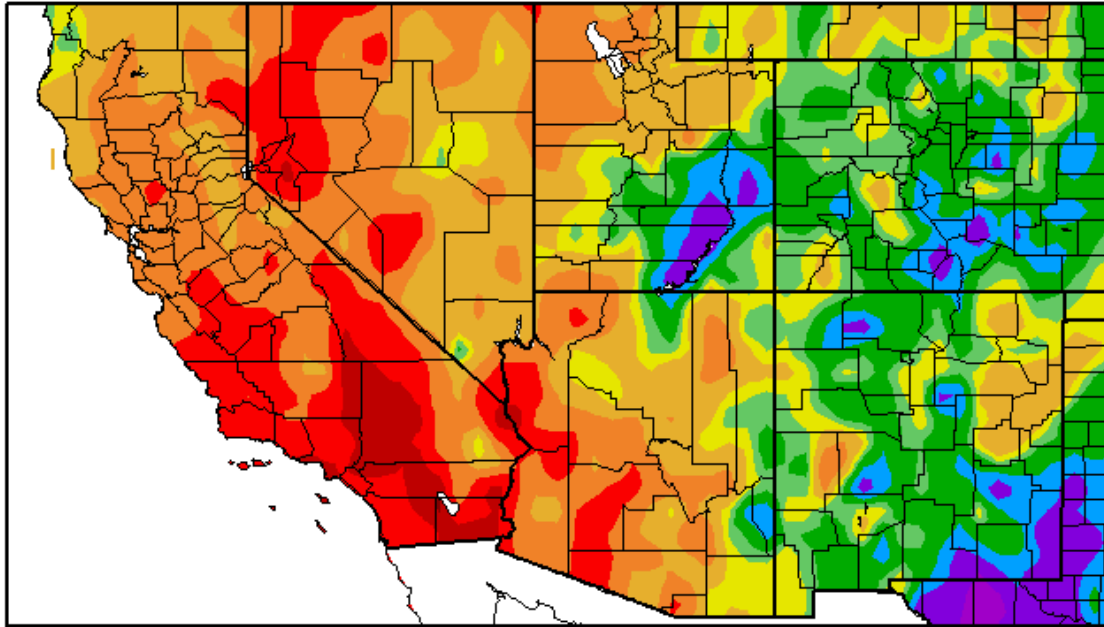
**“Predictions are hard, especially about the future!”
(Nils Bohr)**

What I have learned so far about CA weather/climate

- Different river basins are well correlated with each other (snowpack as well as runoff); looked at eight snowpack basin indices from Bend down to Merced, but this report will mostly focus on **Sacramento and San Joaquin** river runoff indices;
- Three-year droughts are rare (1959-61, 90-92+), and not clearly linked to either ENSO or PDO phase; neither are two-year droughts (33+34, 76+77, 87+88, and 06+07 - so far);
- Southern CA precipitation has a much more straightforward association with ENSO than northern CA (La Niña tends to be dry);
- Good fraction of annual precipitation comes in ‘atmospheric river’ events which are still poorly understood, including their link to ‘Madden-Julian Oscillations’ and ENSO.

What I have learned so far about CA weather/climate

Percent of Normal Precipitation (%)
10/1/2006 – 9/30/2007



Generated 12/12/2007 at HPRCC using provisional data.

NOAA Regional Climate Centers

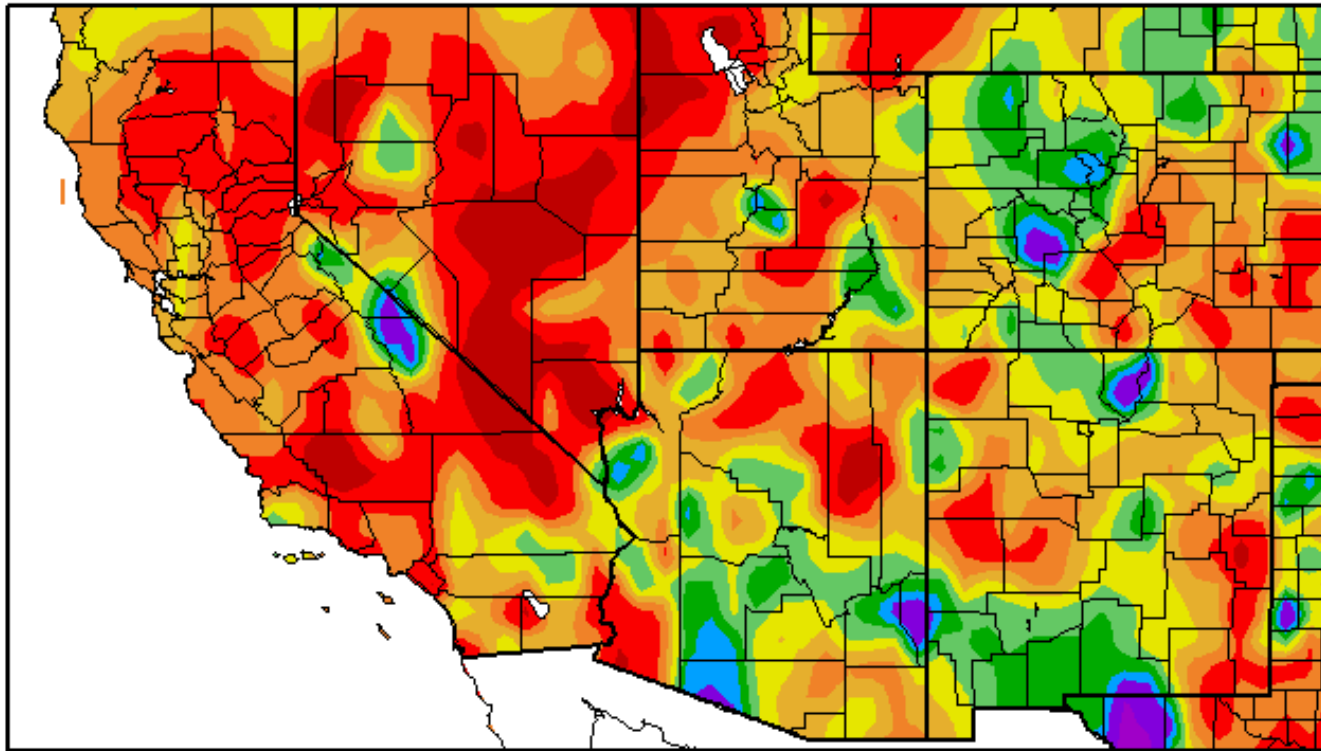
Southern CA drought of 2006-07 was apparently NOT forced by ENSO!

**NOAA-CSI Team
(Hoerling et al., 2008):**

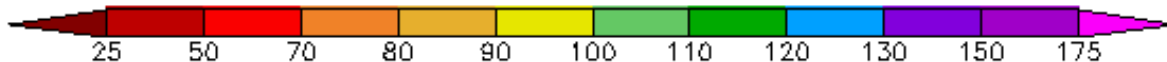
“The principal anomalies in global SSTs during **2006-07**, outside the ENSO region, were warmth in the tropical Indian and Atlantic Oceans, and warmth across much of the extratropical North Pacific and North Atlantic Oceans.... Strong U.S. precipitation sensitivity to this **non-ENSO forcing**... a dry signal occurs along the entire southern tier of states, having a maximum percentage reduction in precipitation over the SW”

What I have learned so far about CA weather/climate

Percent of Normal Precipitation (%)
10/1/2007 – 9/30/2008



2007-08: Very unusual juxtaposition of moderate-strong La Niña with active intraseasonal activity levels which included two major ‘atmospheric river’ events (late November/early December, and early January).

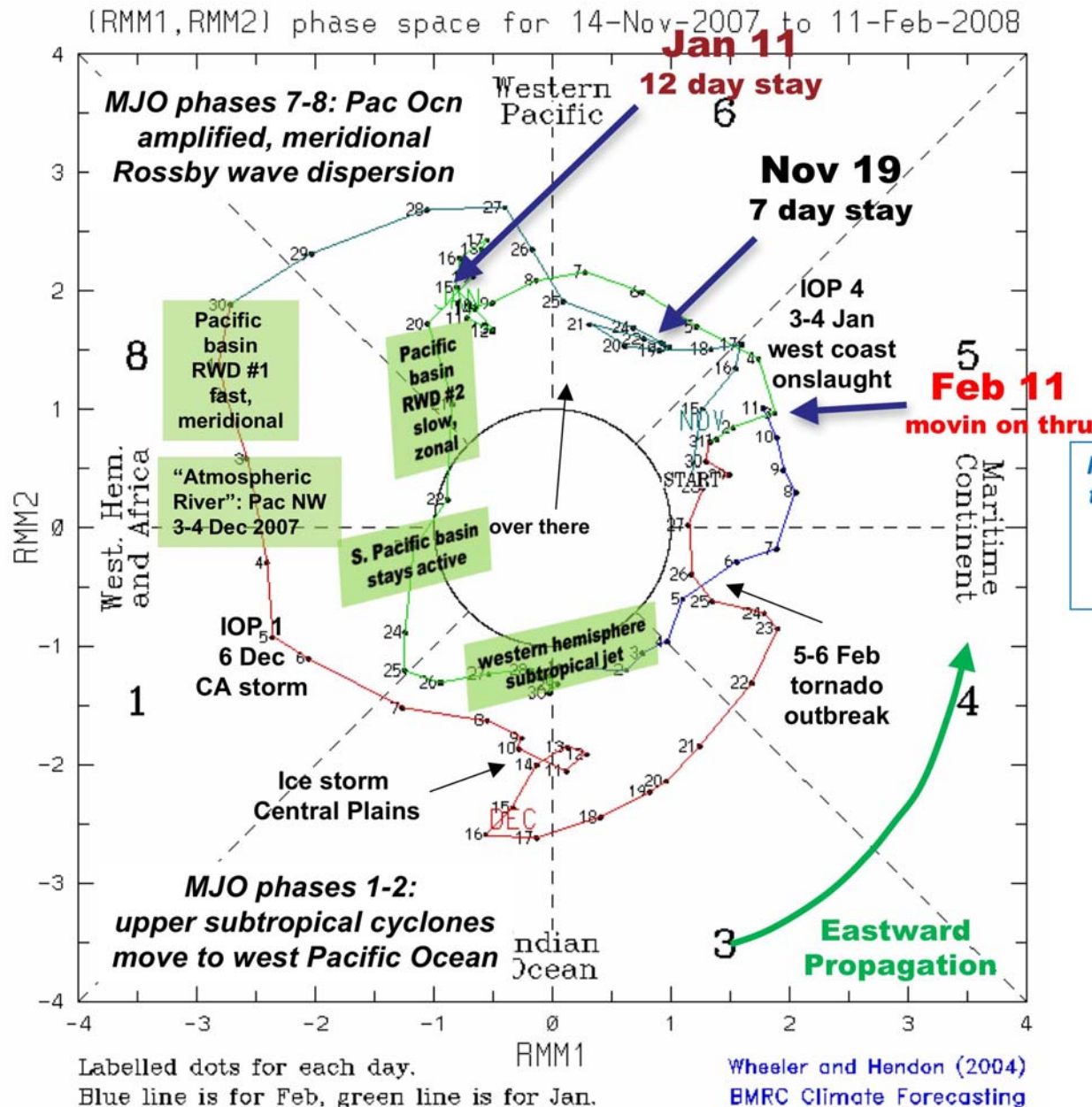


Generated 10/11/2008 at HPRCC using provisional data.

NOAA Regional Climate Centers

Southern CA drought was more or less consistent with La Niña, while timing was not (wet winter).

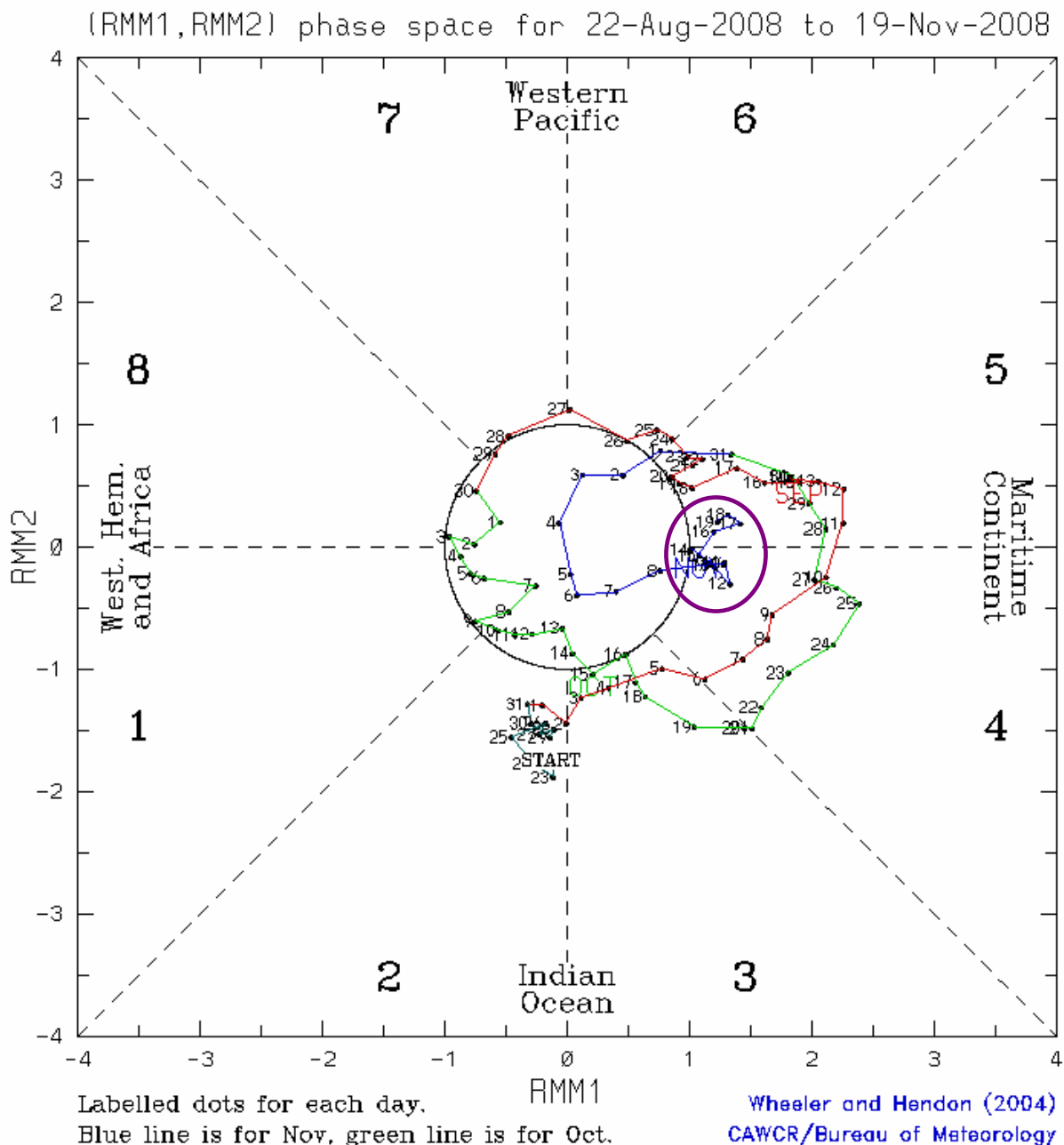
What I have learned so far about CA weather/climate



2007-08: Very unusual juxtaposition of moderate-strong La Niña with active intraseasonal activity levels which included two major 'atmospheric river' events (late November/early December, and early January).

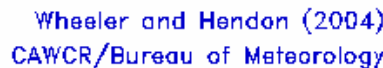
Blue=NOV,
Red=DEC,
Green=JAN,

What I have learned so far about CA weather/climate



So far **this fall**: strong tendency for intraseasonal activity to remain trapped over Indian Ocean/ Indonesia - more typical for La Niña than last year thus far!

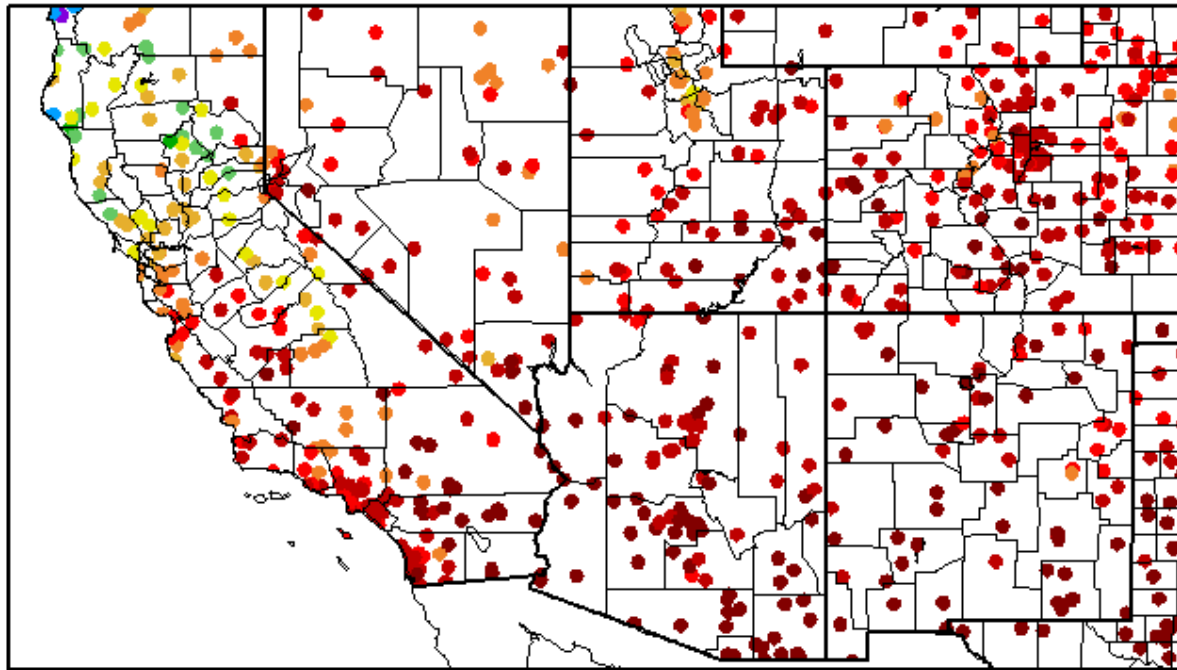
(RMM1,RMM2) phase space for 22-Aug-2008 to 19-Nov-2008
ENSO and 120-day mean have been retained in this projection



So far **this fall**: strong tendency for intraseasonal activity to remain trapped over Indian Ocean/ Indonesia - more typical for La Niña than last year thus far! This is even more discernible, if you **retain the 120-day running mean** in this figure!

What I have learned so far about CA weather/climate

Precipitation (in)
10/18/2008 – 11/16/2008



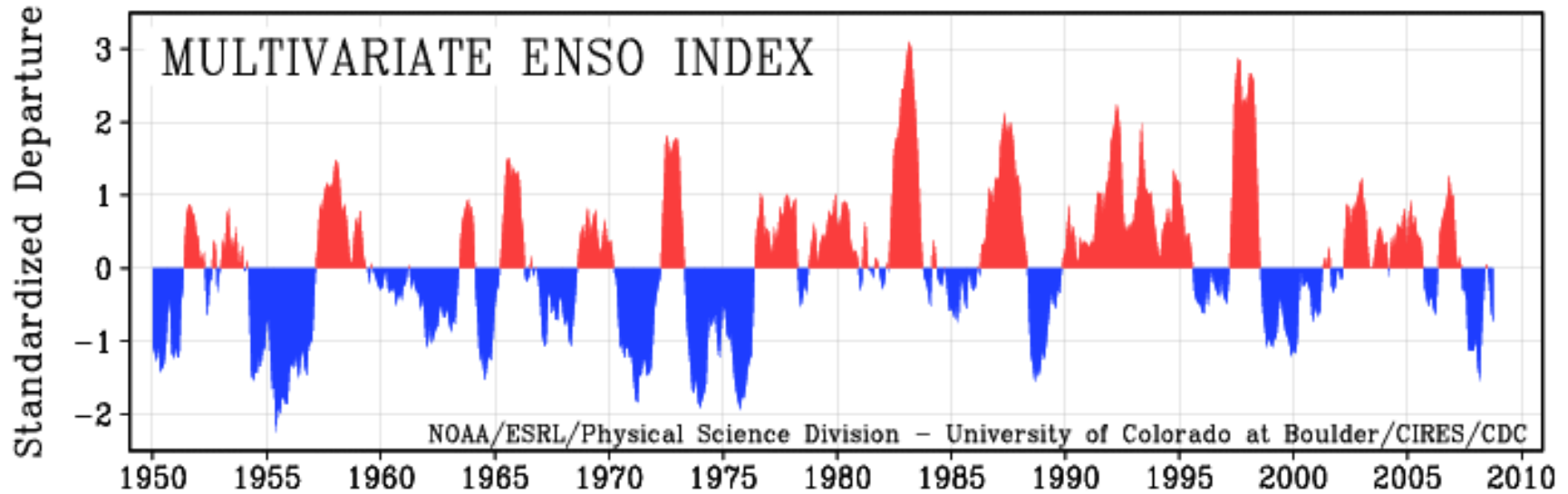
Generated 11/17/2008 at HPRCC using provisional data.

NOAA Regional Climate Centers

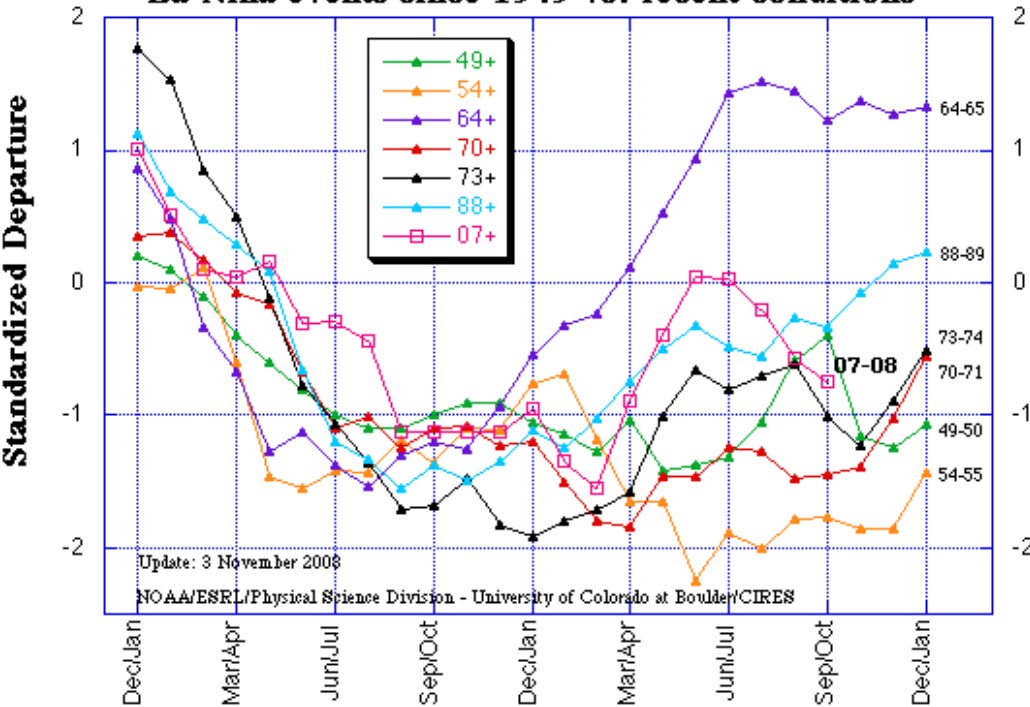
So far **this fall**:

Halloween storm was exceptionally wet in northern California, dropping up to 10" of rain north of Sacramento!

What's going on with ENSO?



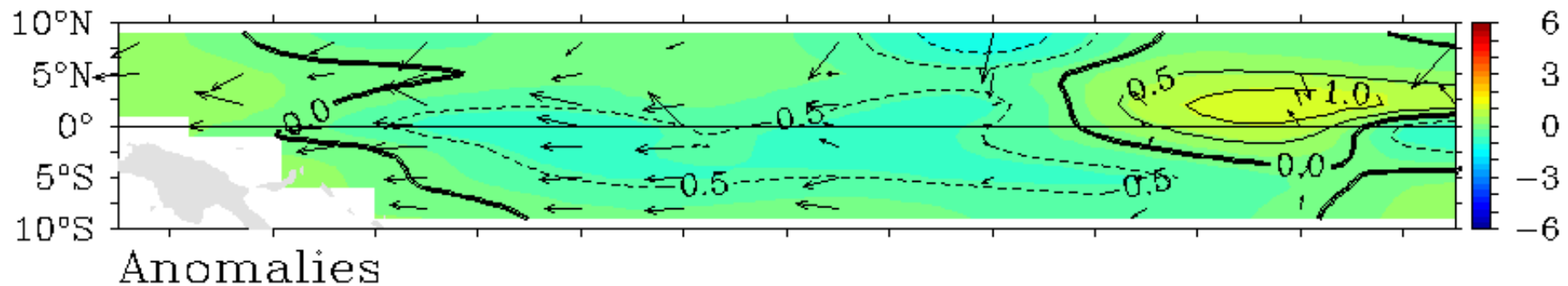
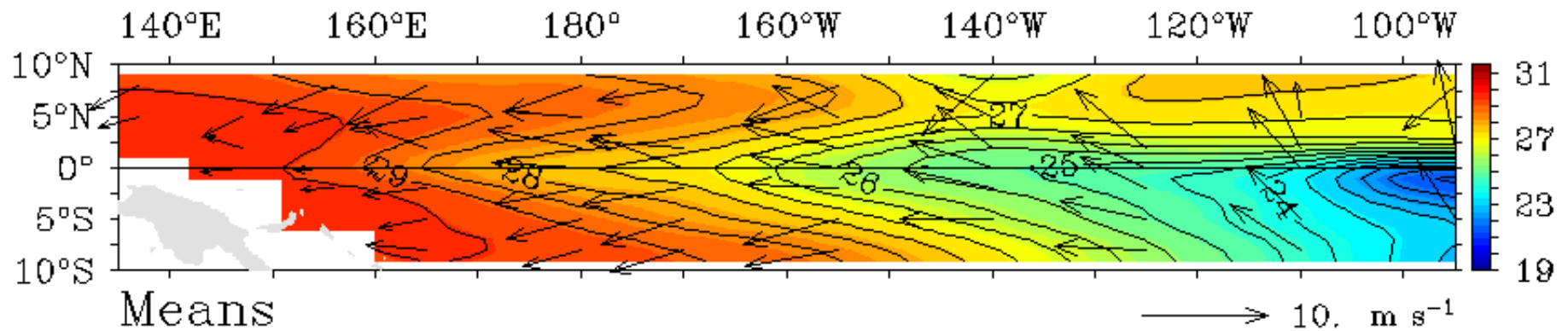
Multivariate ENSO Index (MEI) for 6 strong La Niña events since 1949 vs. recent conditions



Recap of 2008: Fairly strong La Niña event peaked around February, with values last seen in 1988-89. Rose to neutral conditions in early summer, and has been classified as ENSO-neutral by CPC ever since. However, strong trades (high pressure near Tahiti!) and continued negative PDO appear to nudge ENSO-system back into 'La Niña fold', not a typical situation.

What's going on with ENSO?

TAO/TRITON SST ($^{\circ}\text{C}$) and Winds (m s^{-1})

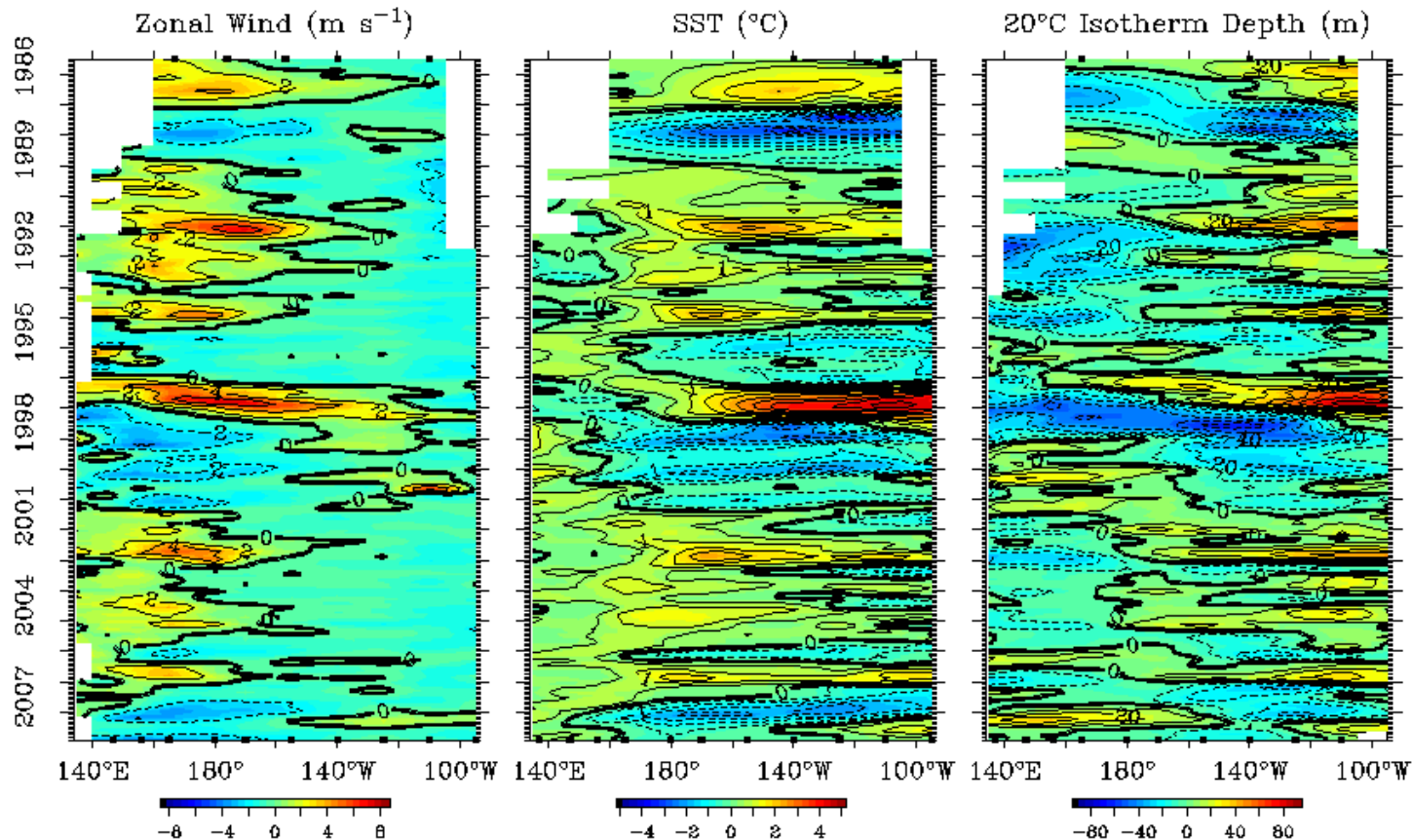


Five-Day Mean Ending on November 19 2008

Current tropical Pacific: Enhanced trade winds near dateline favor renewed La Niña conditions down the road, but it has been somewhat vexing to see near-neutral SST mostly prevail for several months now.

What's going on with ENSO?

Monthly Zonal Wind, SST, and 20°C Isotherm Depth Anomalies 2°S to 2°N Average

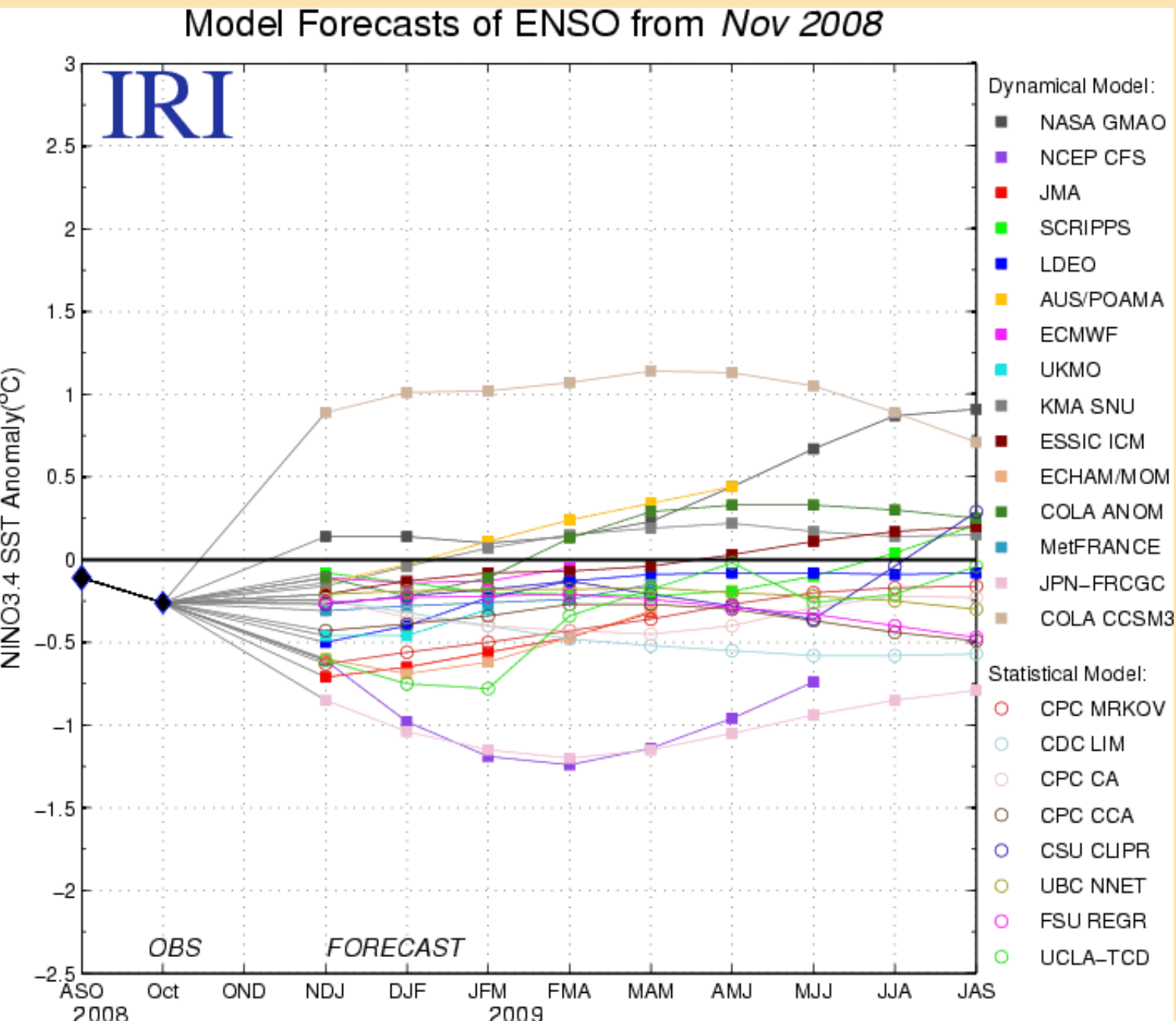


TAO Project Office/PMEL/NOAA

Nov 20 2008

Longer perspective: Enhanced trade winds near dateline compare favorably to historic events (left), subsurface heat content (right) has been a bit anemic (not cold enough), and warm SST east (middle) was unusual during La Niña sequence.

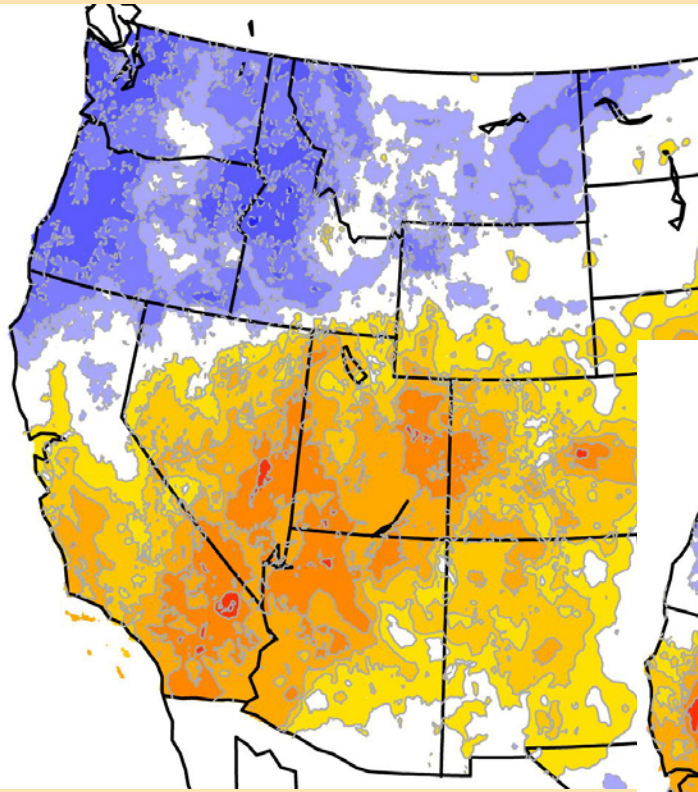
What's going on with ENSO?



Most recent ENSO forecasts: Except for one model, all remaining models either maintain 'neutral' status quo, or develop weak-to-moderate La Niña conditions this winter. This is the state of the art of ENSO forecasting (they can't be all right)!

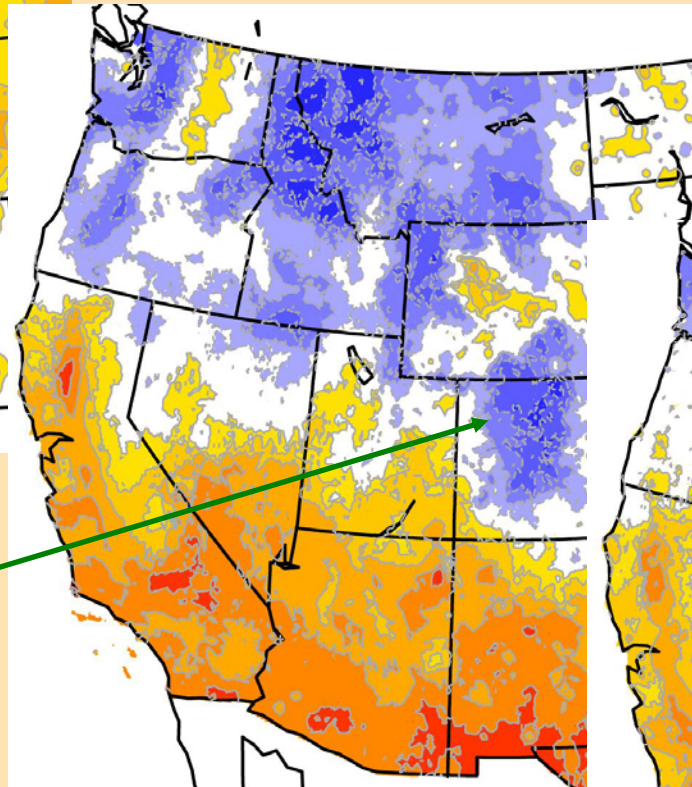
What are typical impacts in Western U.S.?

MEI vs. seasonal precipitation: fall is the only season that typically brings more rain to northern CA with La Niña - other seasons and regions tend to be wetter with El Niño, especially in lower elevations, southern parts of the state, and spring!

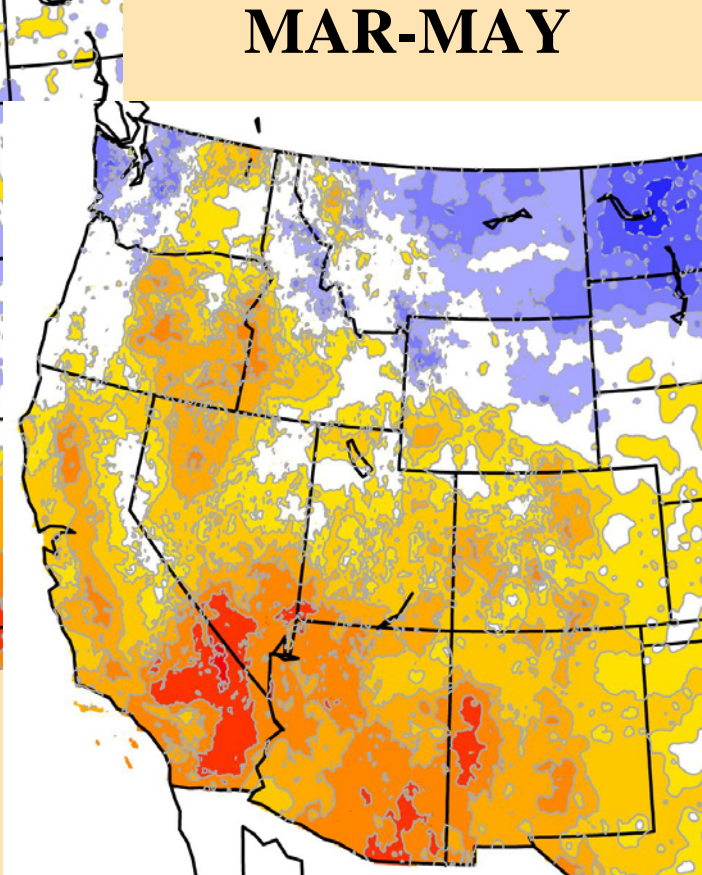


SEP-NOV

**Upper Colorado
basin prefers La
Niña during winter!**



DEC-FEB



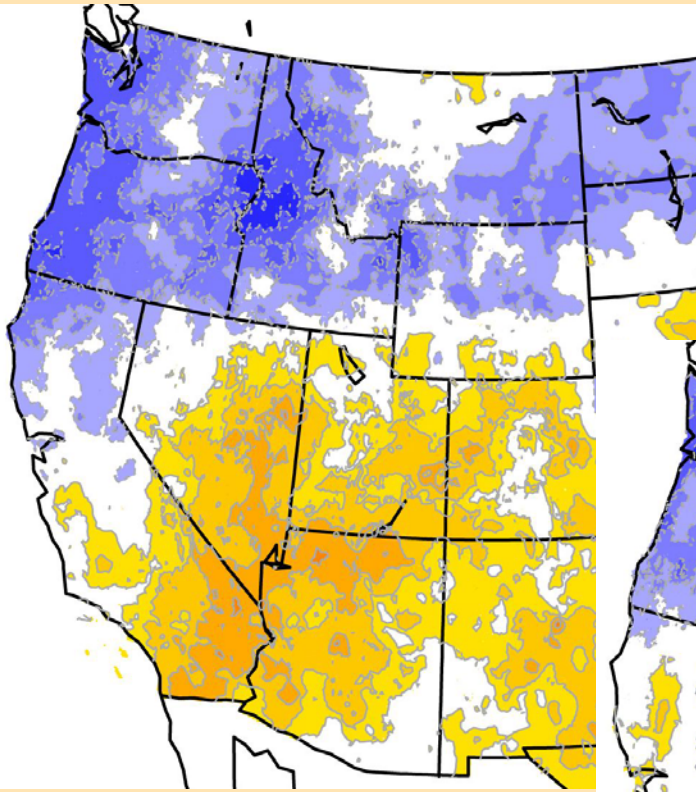
MAR-MAY

Correlation Coefficient

-0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.1 0.2 0.3 0.4 0.5 0.6

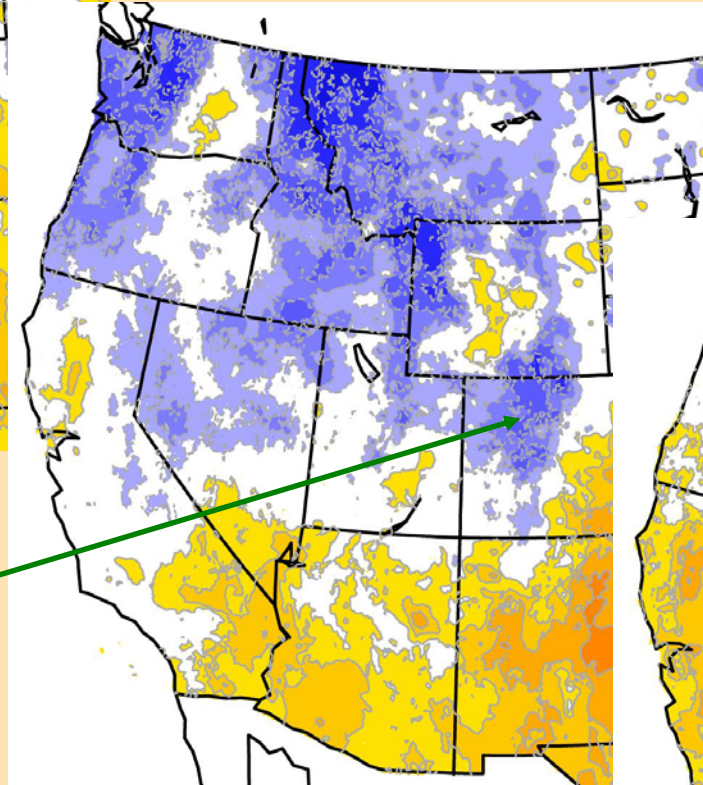
What are typical impacts in Western U.S.?

PDO vs. seasonal precipitation: negative PDO is slightly more favorable than La Niña north-central CA (fall and winter), but overall correlations are weaker than for ENSO-relationships.

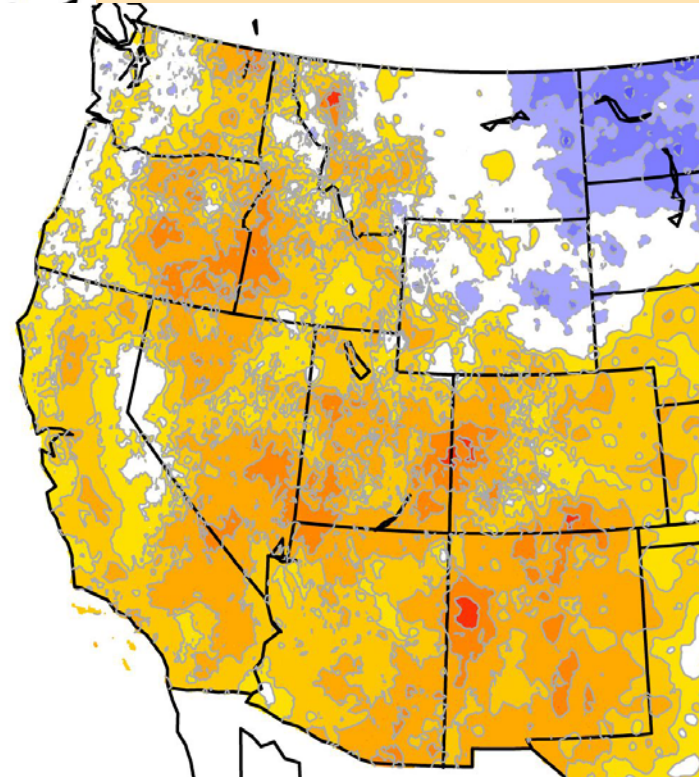


SEP-NOV

Upper Colorado basin prefers negative PDO phase during winter!



DEC-FEB

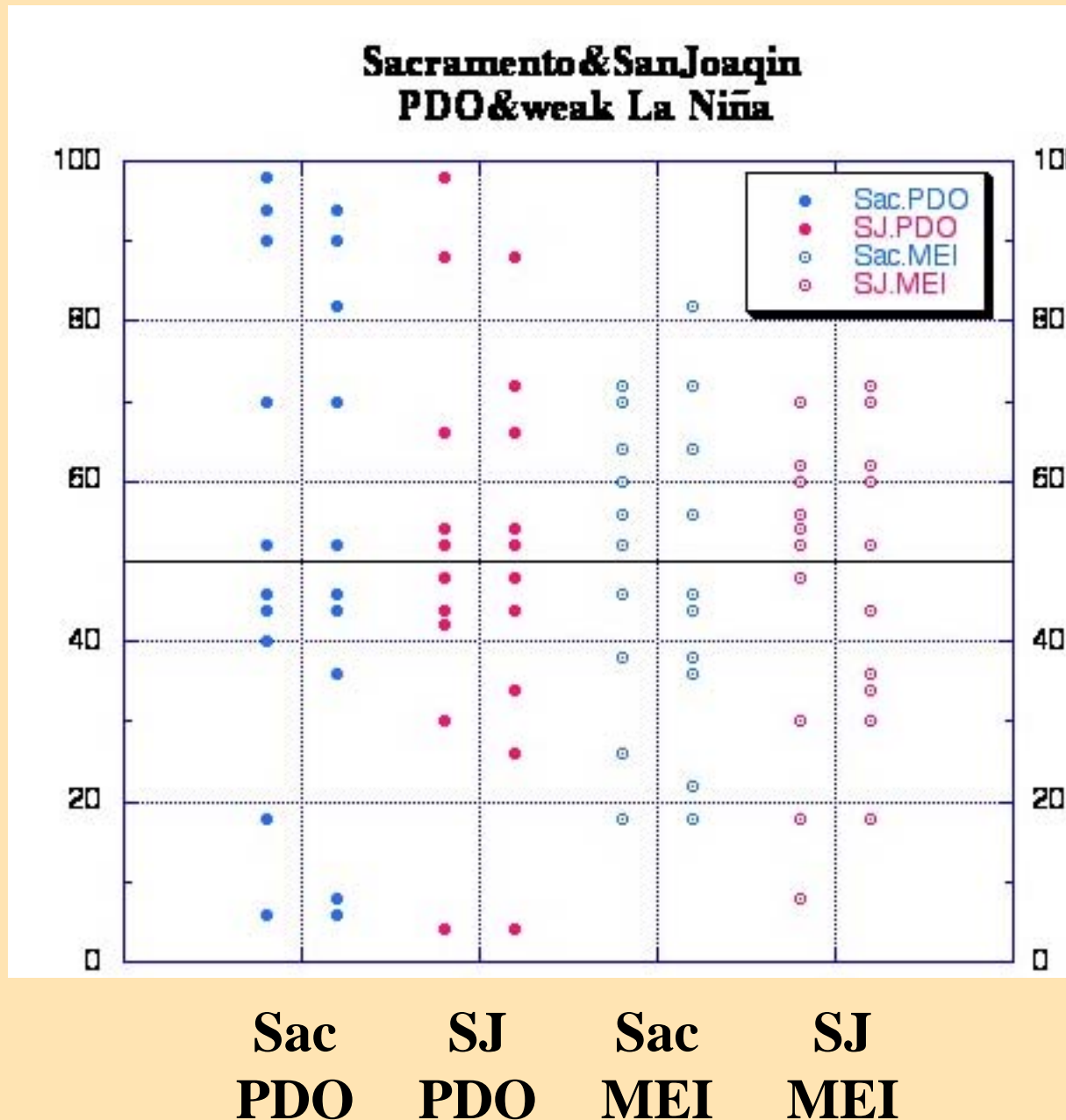


MAR-MAY

Correlation Coefficient

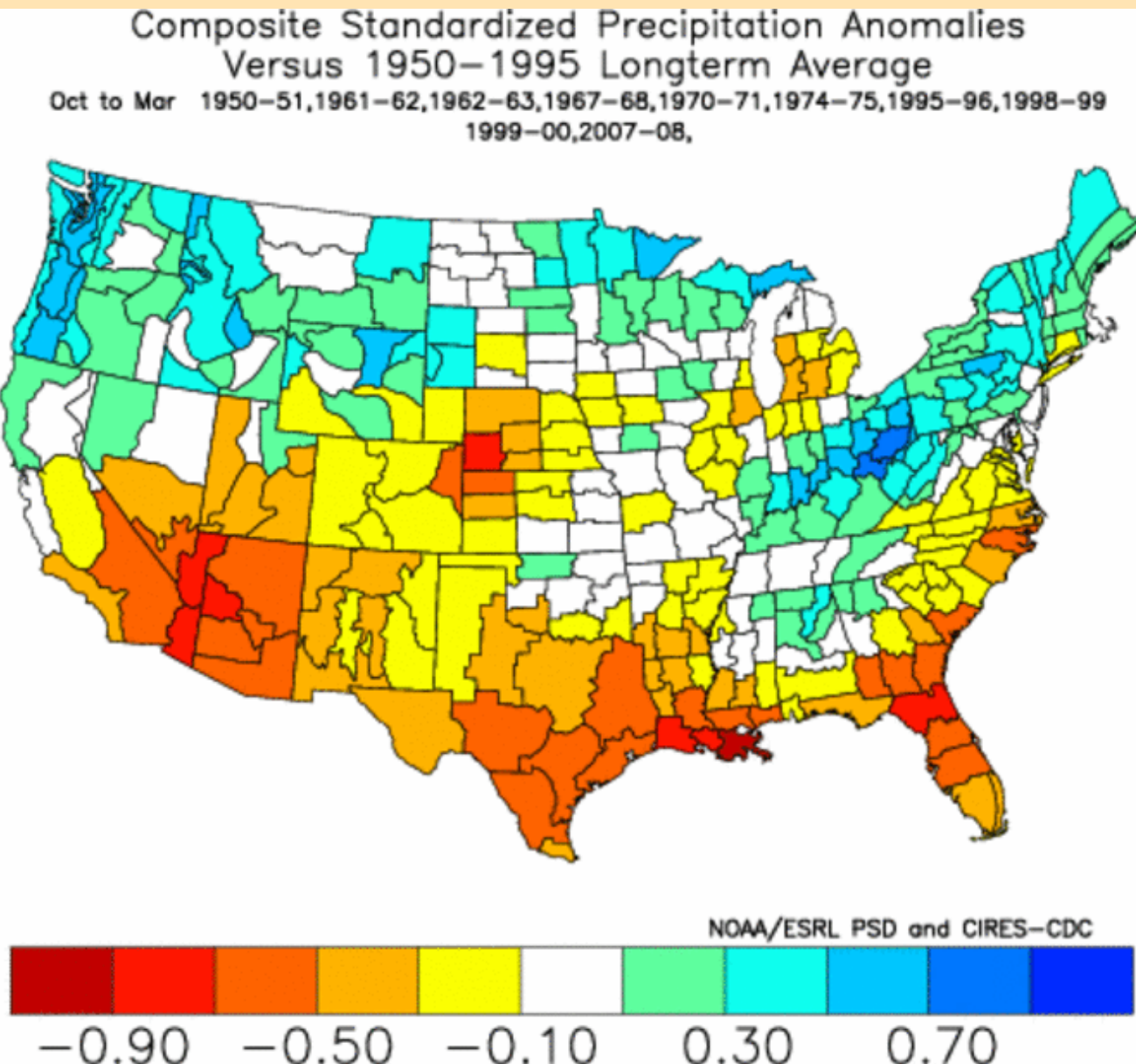
-0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.1 0.2 0.3 0.4 0.5 0.6

What are typical impacts in Western U.S.?



Water Year runoff percentiles: 10
strongest negative PDO cases in 1956-2005 and 10 most similar weak La Niña cases for Sacramento and San Joaquin River indices show no preference for high or low runoff (left column uses **fall** classification, right **winter**)

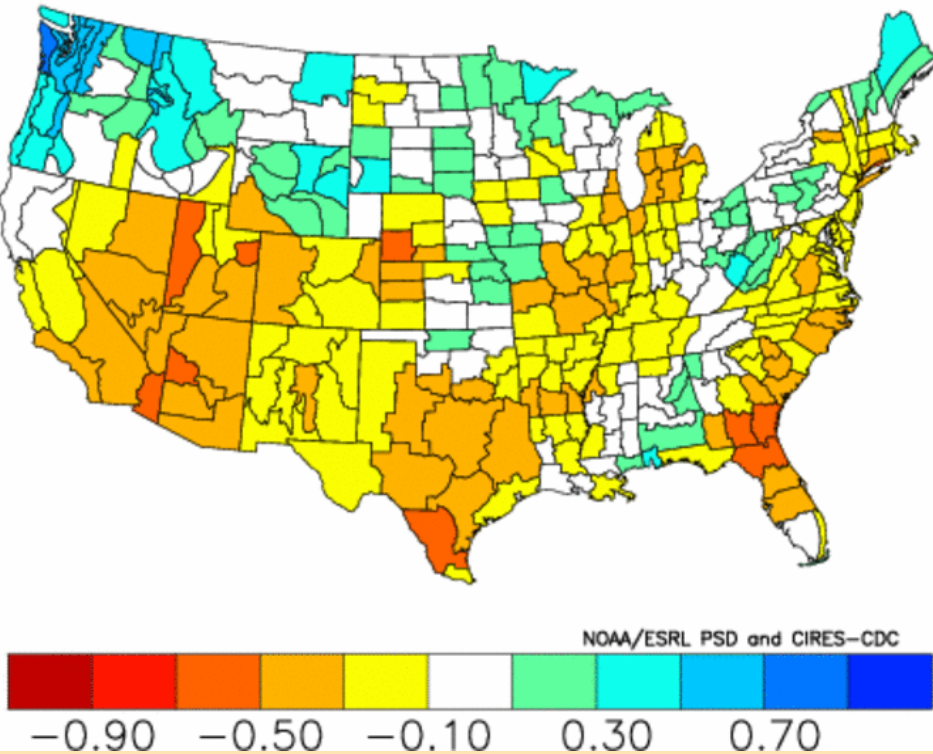
What are typical impacts in Western U.S.?



October-March
Precipitation: 10
most similarly weak
La Niña cases (**fall**)
show little tilt in
northern California,
and dry outcome in
southern CA.

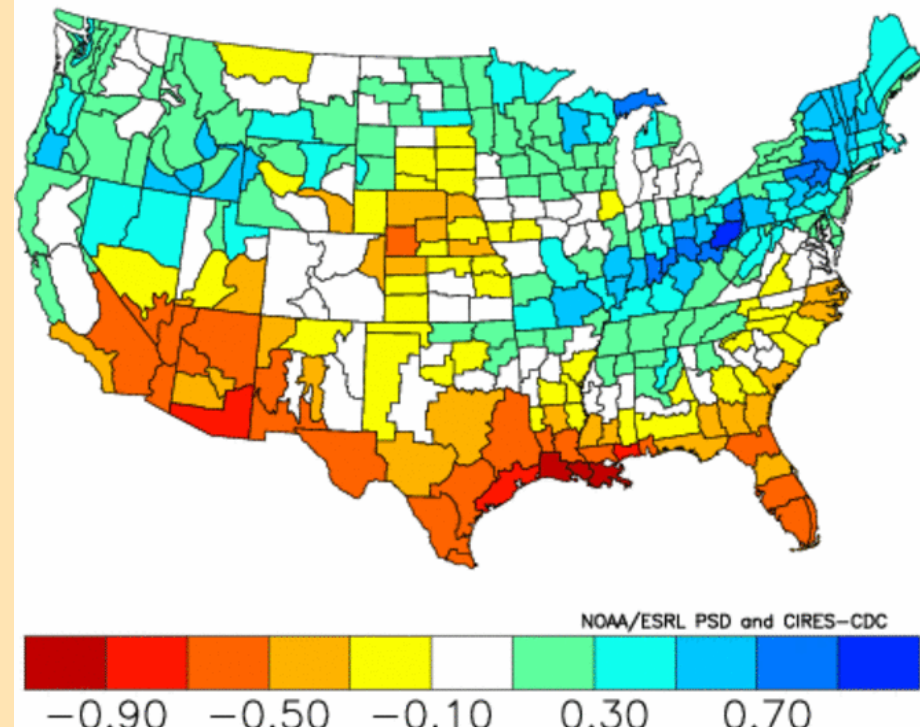
What are typical impacts in Western U.S.?

Composite Standardized Precipitation Anomalies
Oct to Dec 1950,1961,1962,1967,1970,1974,1995,1998,1999,2007
Versus 1950–1995 Longterm Average

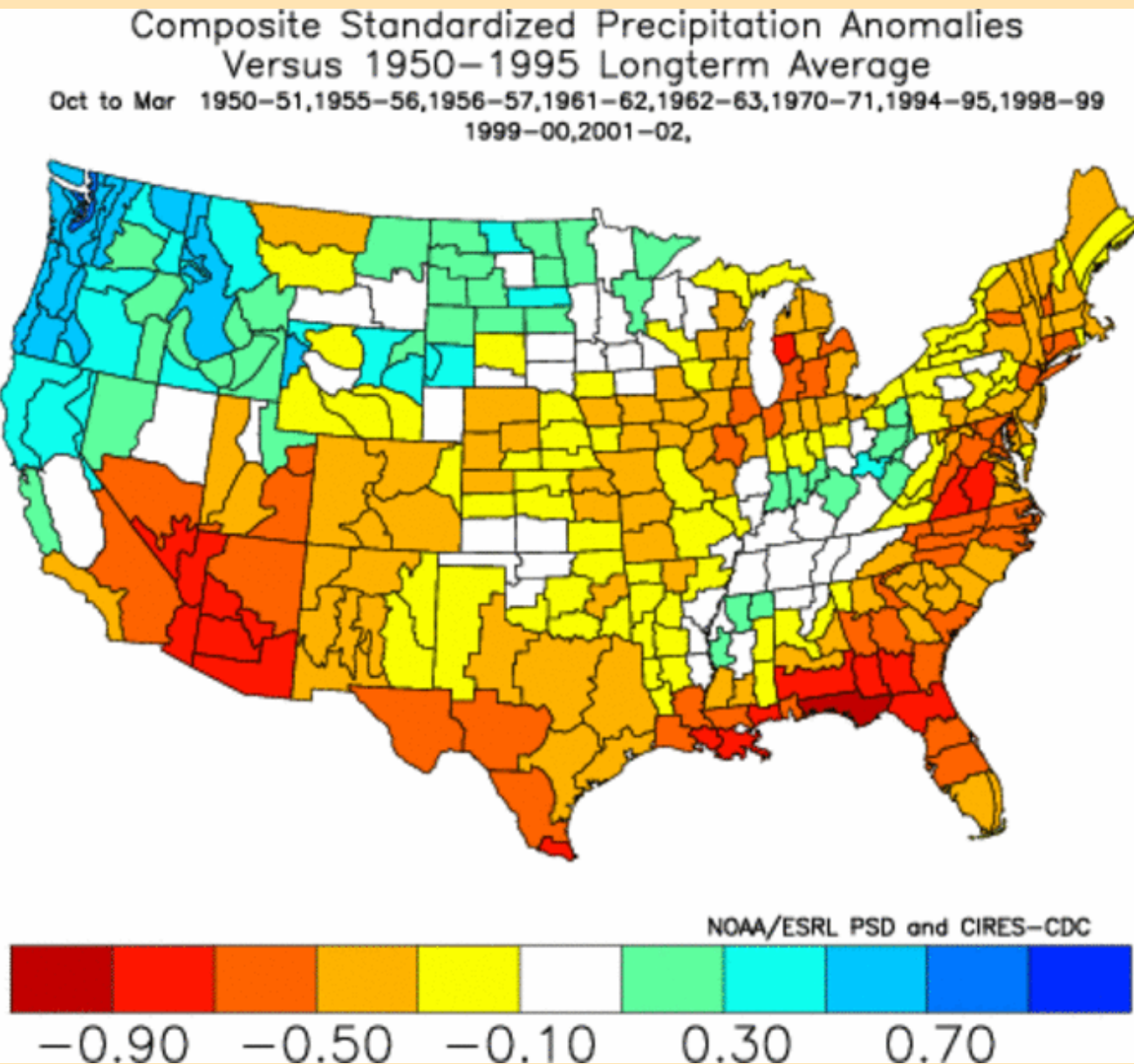


**October-December &
January-March Precipitation:**
10 most similarly weak (fall) La Niña cases show divergent trends for northern vs. southern CA (“wetter” vs. “drier”).

Composite Standardized Precipitation Anomalies
Jan to Mar 1951,1962,1963,1968,1971,1975,1996,1999,2000,2008
Versus 1950–1995 Longterm Average



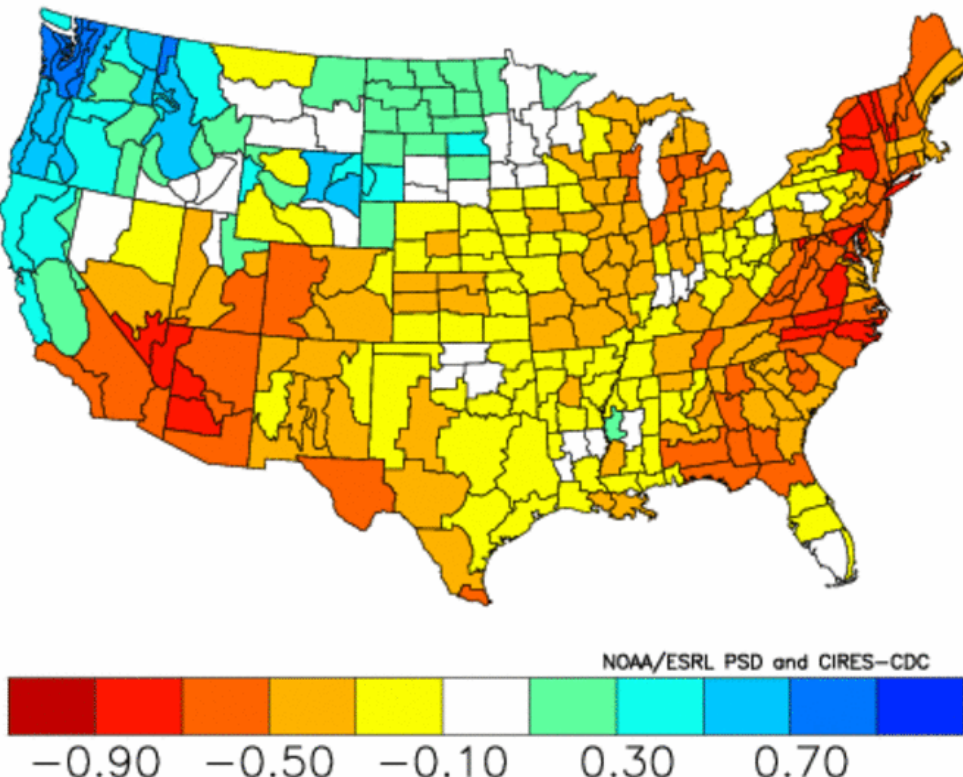
What are typical impacts in Western U.S.?



**October–March
Precipitation:** 10
strongest negative
(fall) PDO cases
show slight
preference for wet
outcome in northern
California, and dry
outcome in southern
CA. Similar
outcome, even
though overlap is
only six out of 10
cases! This leaves
current debate about
La Niña irrelevant...

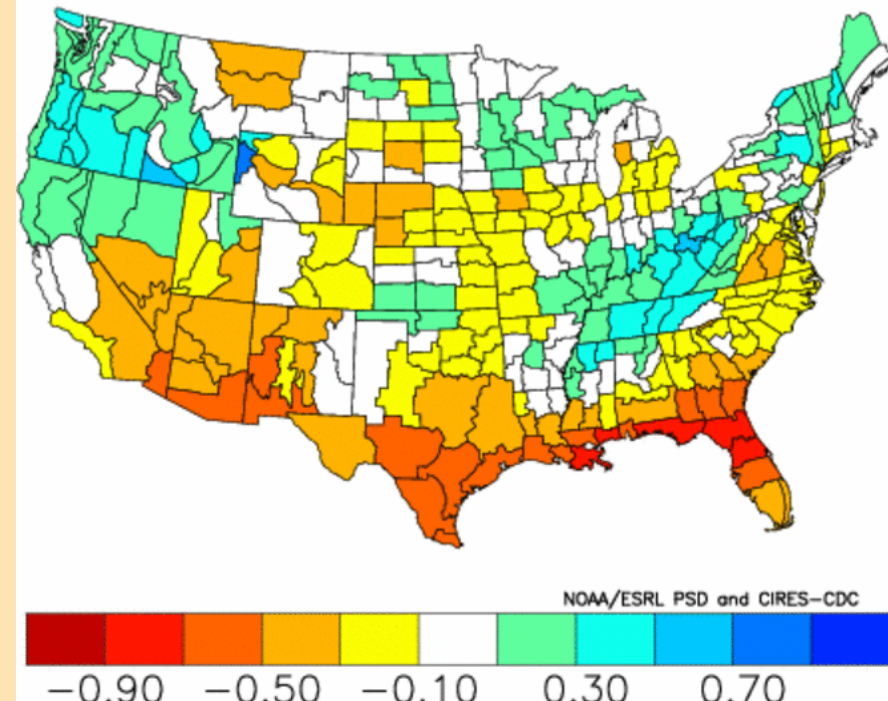
What are typical impacts in Western U.S.?

Composite Standardized Precipitation Anomalies
Oct to Dec 1950,1955,1956,1961,1962,1970,1994,1998,1999,2001
Versus 1950–1995 Longterm Average



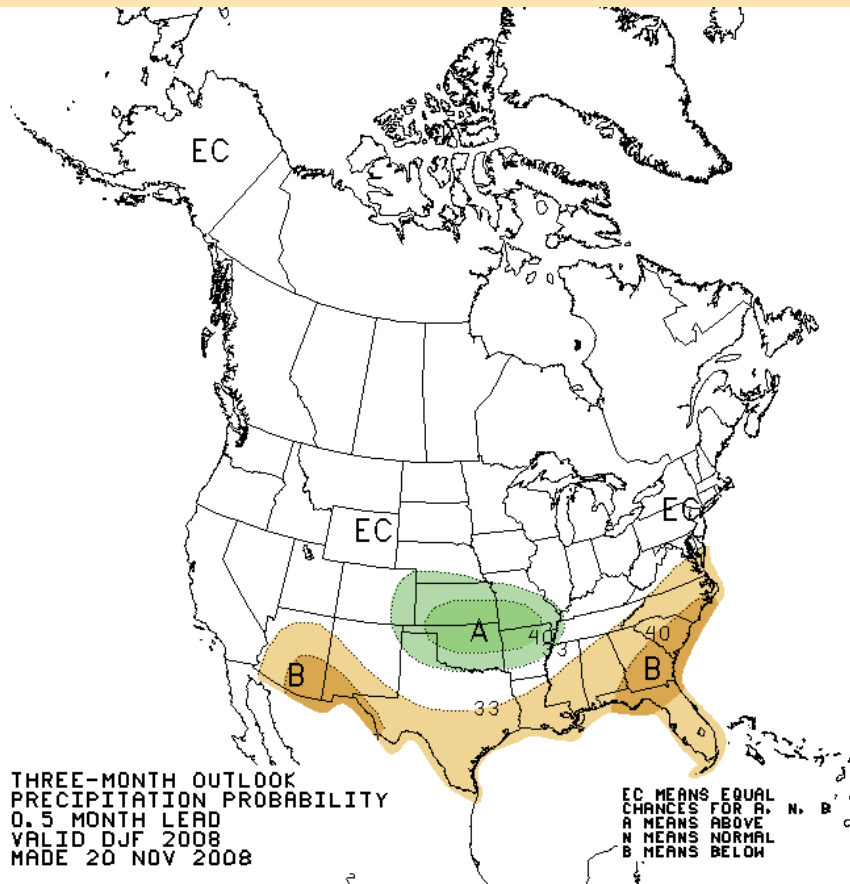
Oct-Dec vs. Jan-Mar Precip: 10 strongest negative (fall) PDO cases start out wetter in northern CA, only to dry somewhat later in winter, while southern CA starts out dry, but ends up less dry (~).

Composite Standardized Precipitation Anomalies
Jan to Mar 1951,1956,1957,1962,1963,1971,1995,1999,2000,2002
Versus 1950–1995 Longterm Average

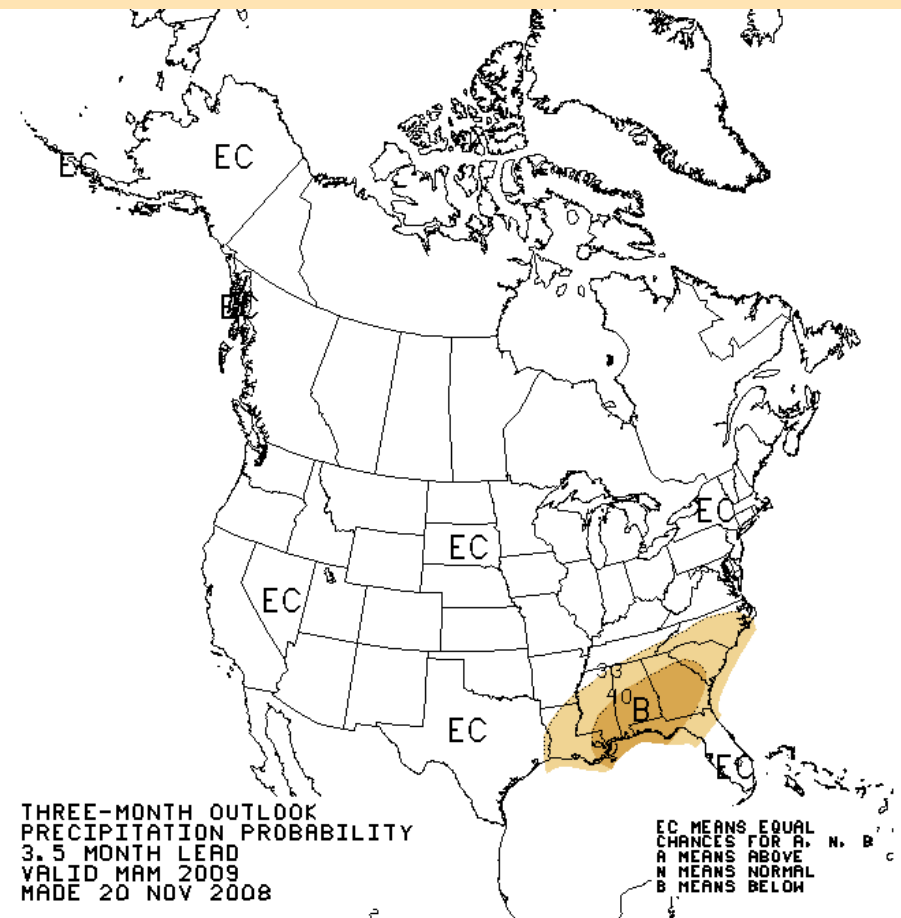


What is the 'official' word from the Climate Prediction Center?

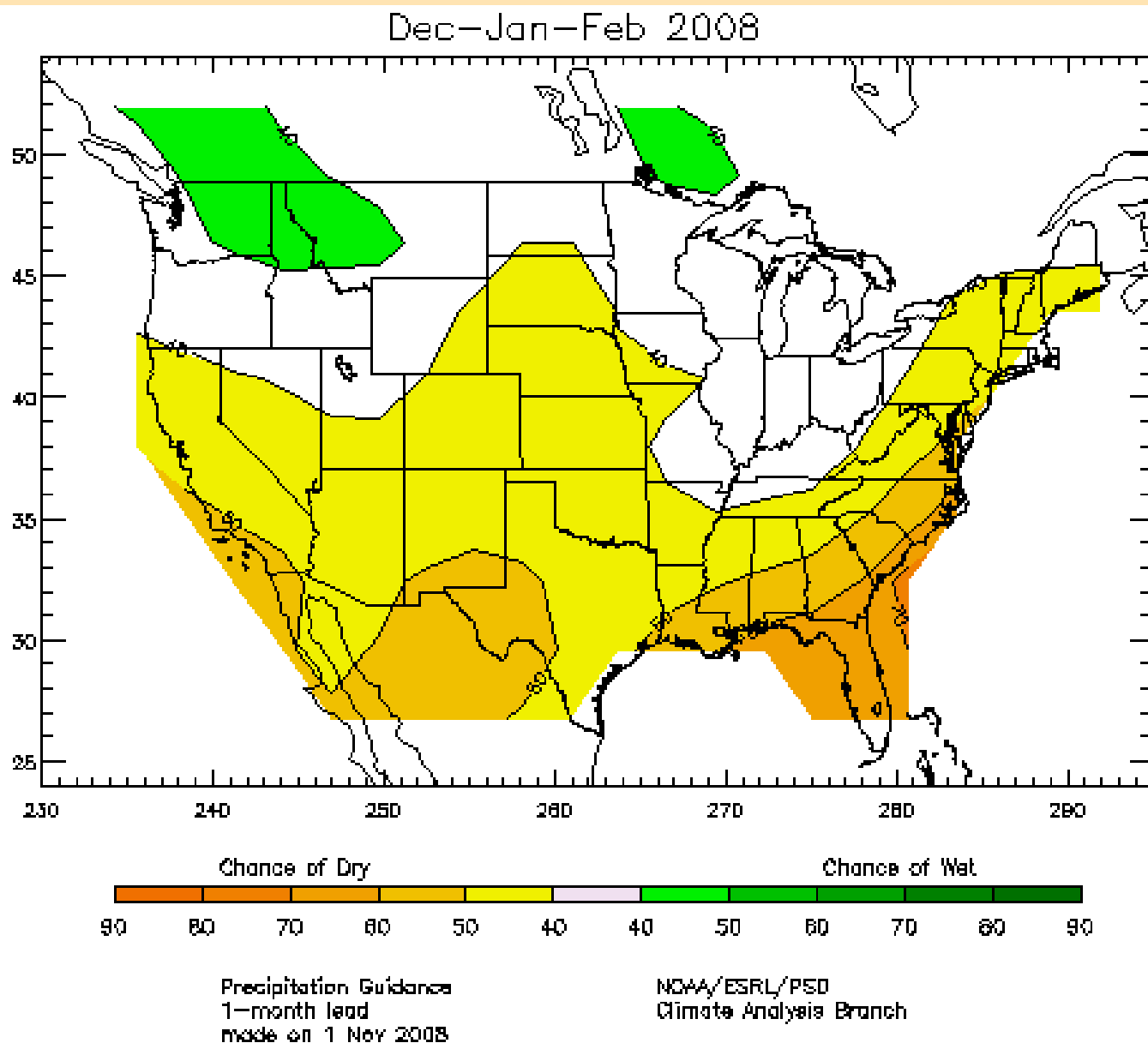
‘ENSO neutral’ winter:
They are not sticking their neck out for CA! “EC” means no tilt in the odds.



Uncertain ENSO phase in spring: Even more uncertainty down the road!

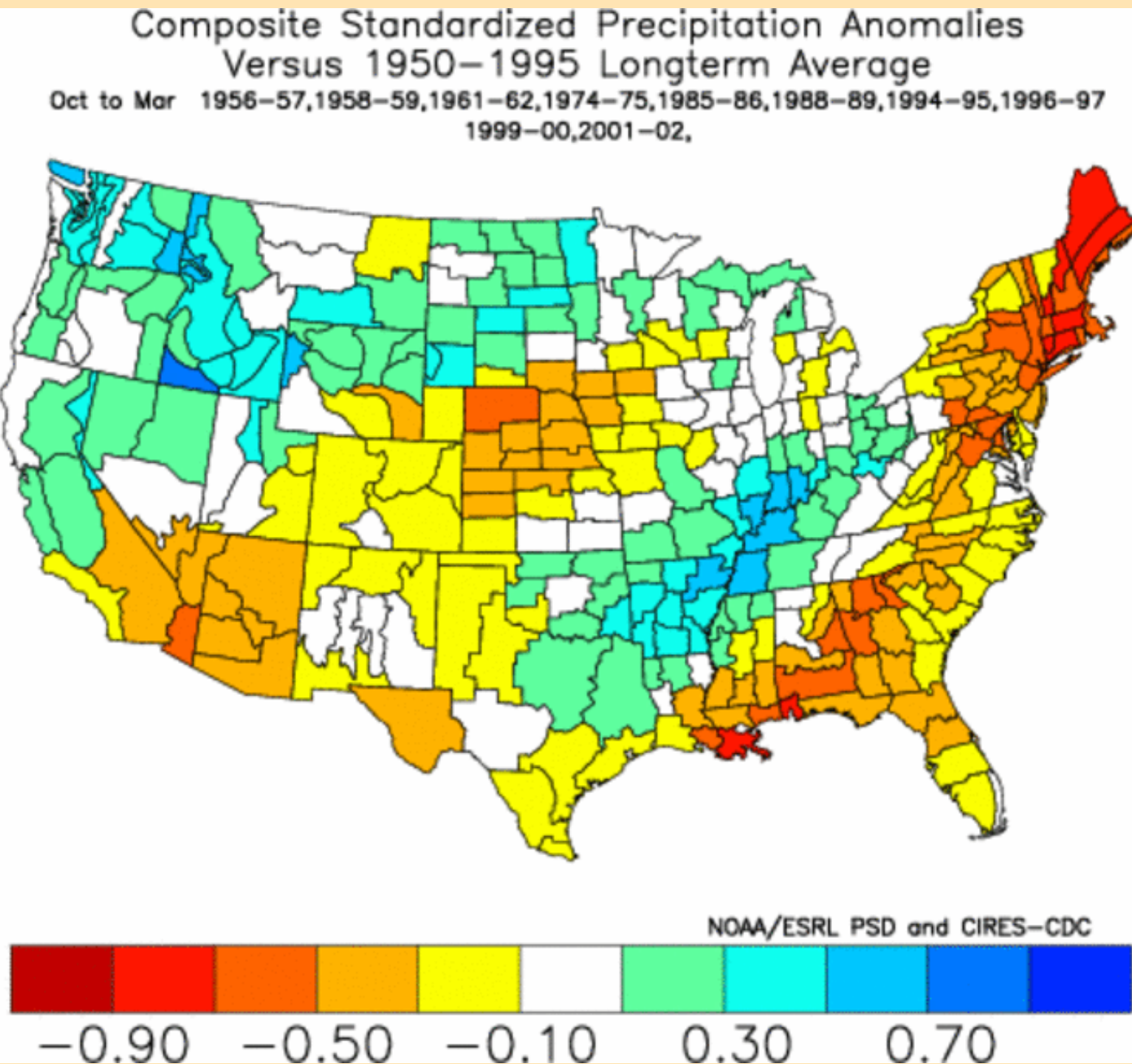


What is experimental NOAA/ESRL (Hoerling et al.) outlook?



Statistically derived model outcome if average SST projections are used:
Slight tilt toward dry winter in CA, overall La Niña 'flavor'!

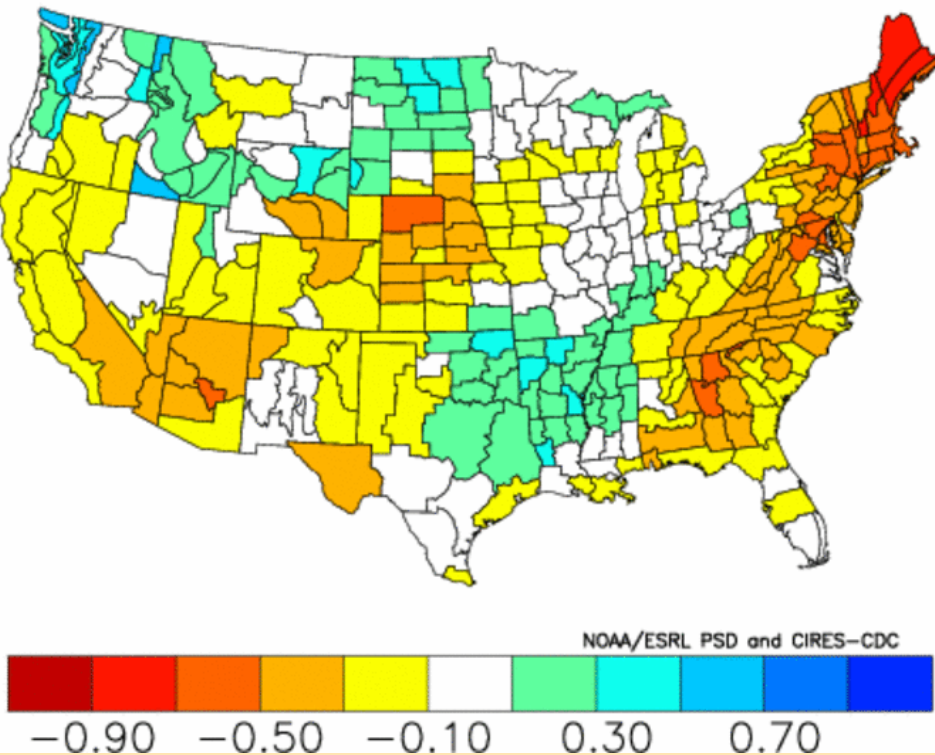
What else might be going on - Forecasts of Opportunity?



Alaska: October was very cold, and November continues in same vein - this is a tell-tale sign of neutral or La Niña conditions, and often yields dry conditions in southern CA and normal-to-above-normal in northern CA... familiar?!

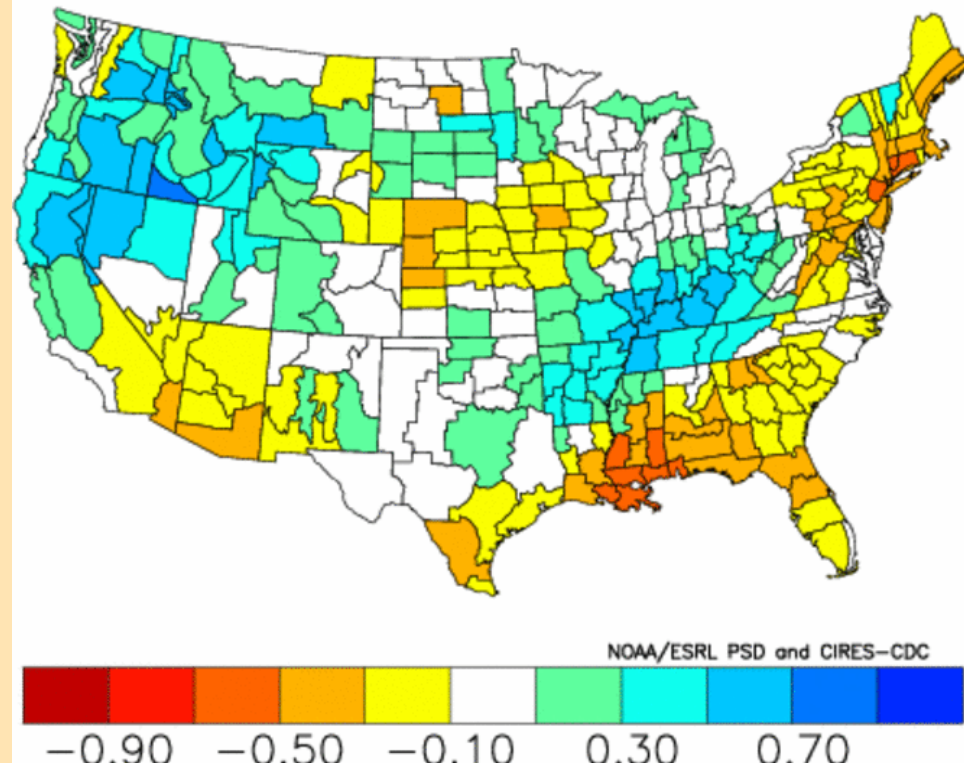
What else might be going on - Forecasts of Opportunity?

Composite Standardized Precipitation Anomalies
Oct to Dec 1956,1958,1961,1974,1985,1988,1994,1996,1999,2001
Versus 1950–1995 Longterm Average

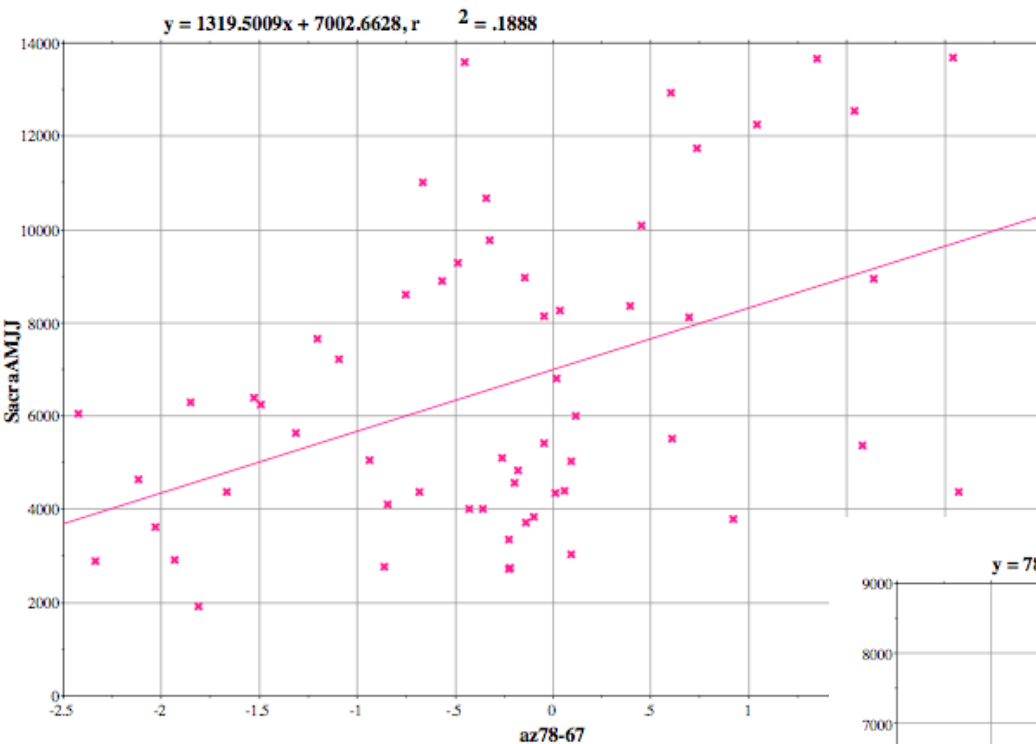


Alaska: 10 cases with cold
Oct&Nov in central Alaska
- starts out dry, ends up wet
in northern CA!

Composite Standardized Precipitation Anomalies
Jan to Mar 1957,1959,1962,1975,1986,1989,1995,1997,2000,2002
Versus 1950–1995 Longterm Average

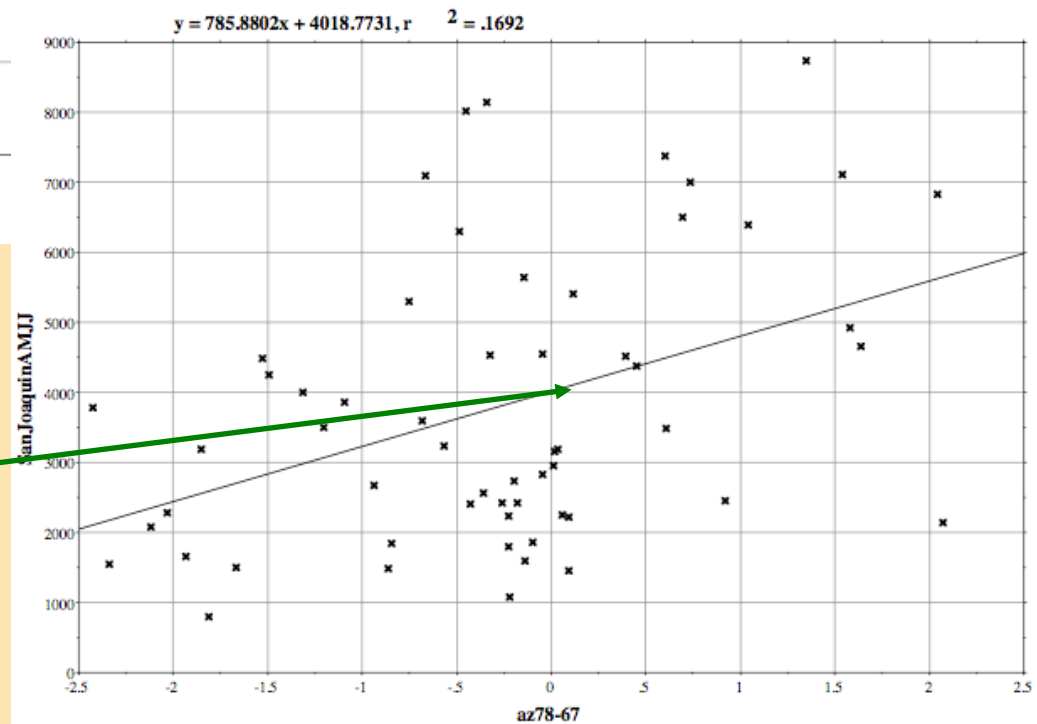


A poorly understood connection to the Azores high

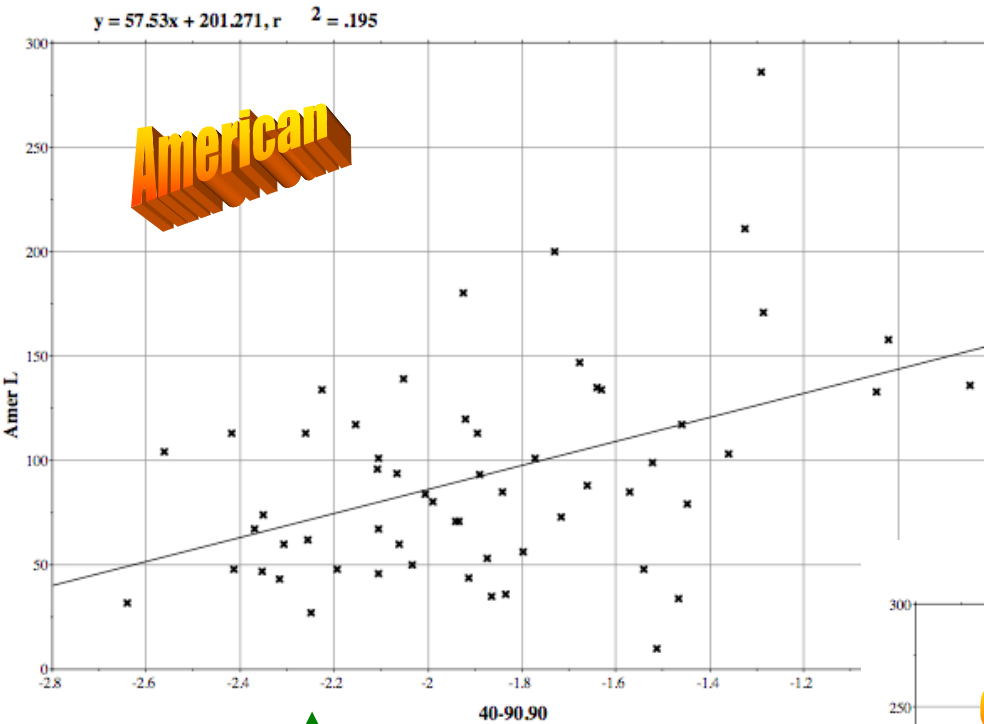


Summer trend in SLP near Azores: Rising pressure in subtropical North Atlantic is often followed by good runoff in Sacramento and San Joaquin basins! 2009 has slight tilt towards wet conditions.

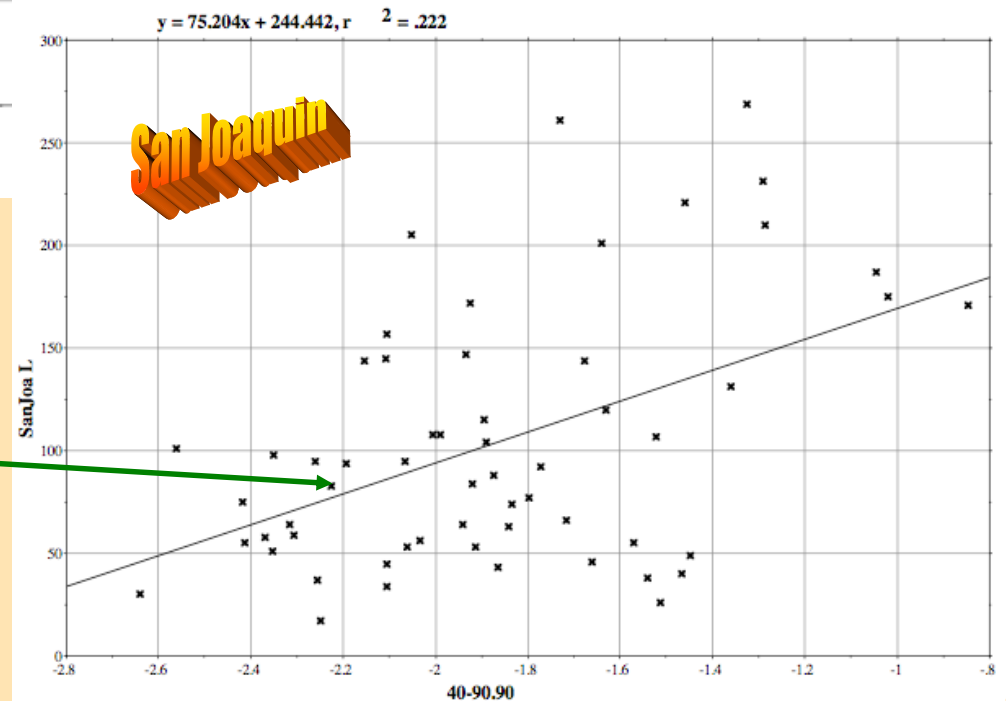
2008



Indian Ocean Dipole - particularly influential in sub-basins

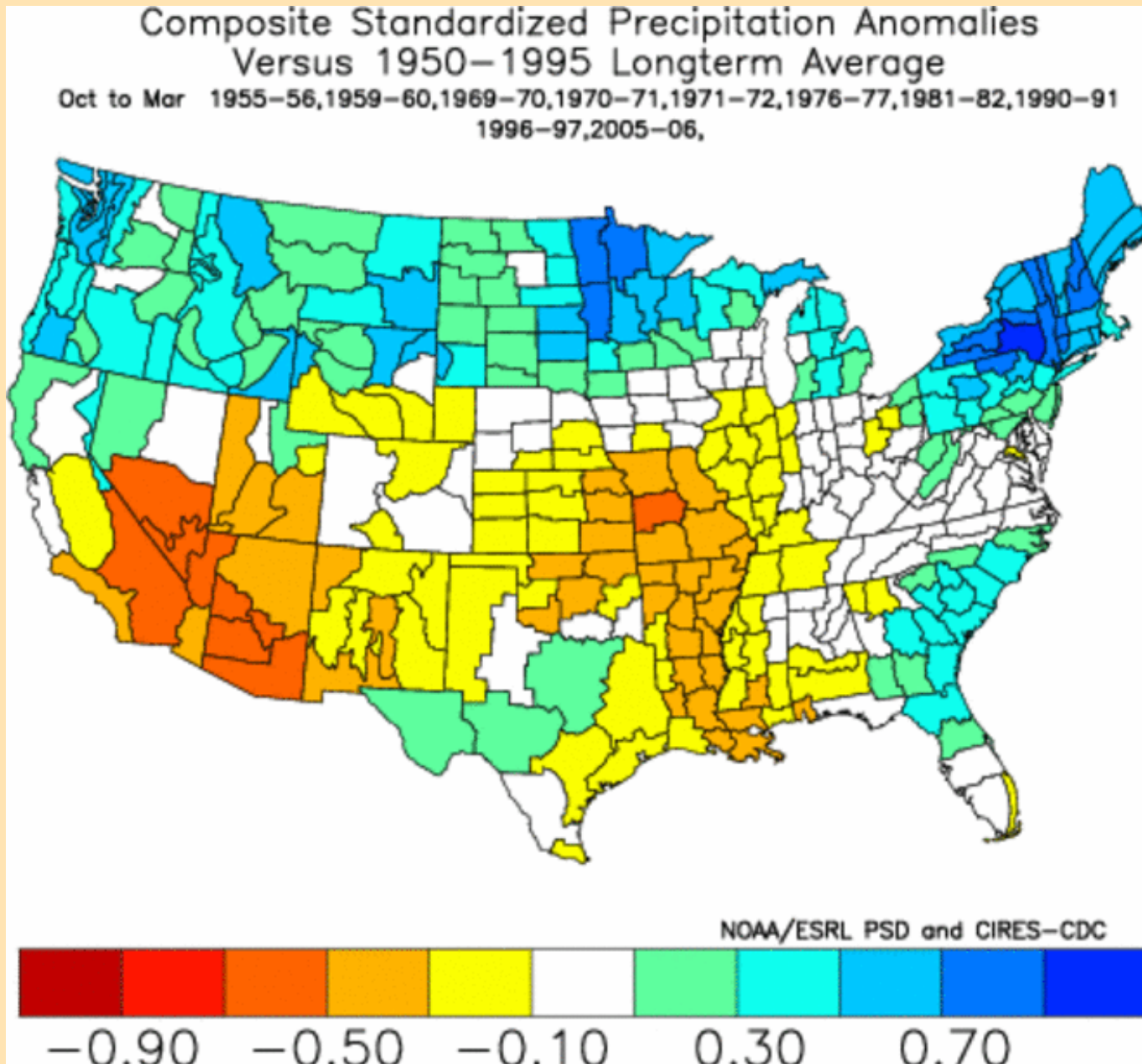


Fall IOD: Relatively warm SST near Indonesia is linked to decreased 1 April snowpack in American (left) and San Joaquin basins (bottom; both lower elevation indices). Based on this association alone, 2009 is more likely to end up below-average.



2008

Indian Ocean Dipole - analog years

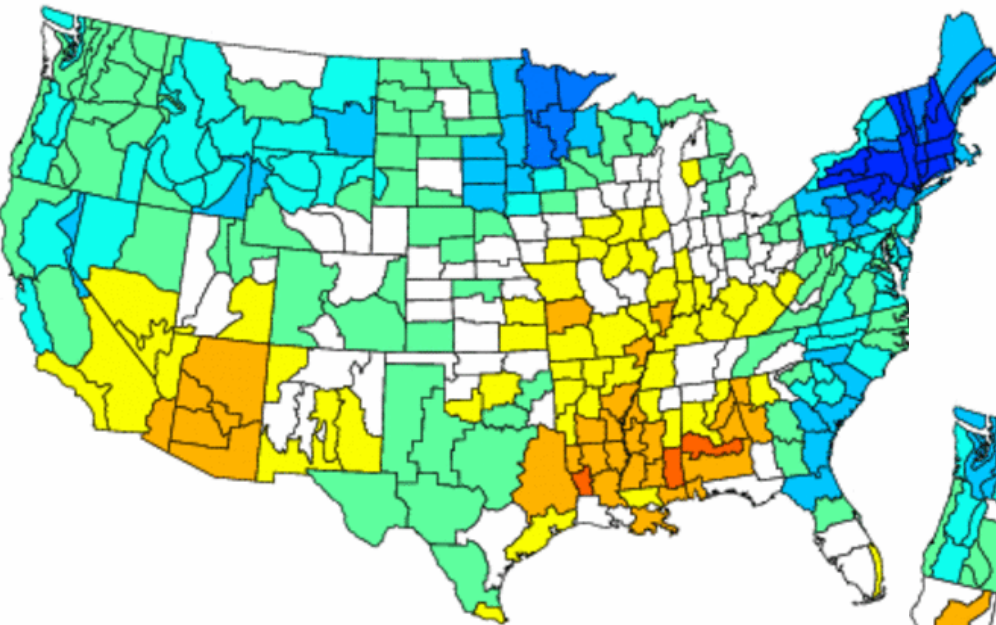


Fall IOD:

Low index cases (warm eastern Indian Ocean) similar to 2008 often yield a dry winter half-year in southern California, while the north could go either way...

Indian Ocean Dipole - analog years

Composite Standardized Precipitation Anomalies
Oct to Dec 1955,1959,1969,1970,1971,1976,1981,1990,1996,2005
Versus 1950–1995 Longterm Average

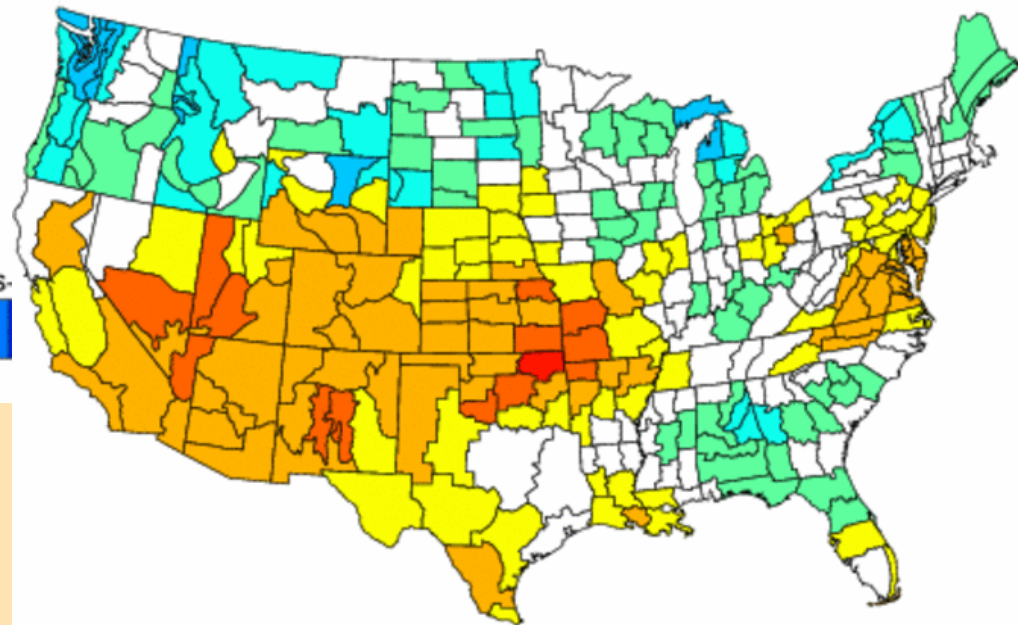


NOAA/ESRL PSD and CIRES-

-0.90 -0.50 -0.10 0.30 0.70

Fall IOD: Low index years similar to 2008 appear to start out “wet” in northern CA, but tend to dry out everywhere in late winter.

Composite Standardized Precipitation Anomalies
Jan to Mar 1956,1960,1970,1971,1972,1977,1982,1991,1997,2006
Versus 1950–1995 Longterm Average

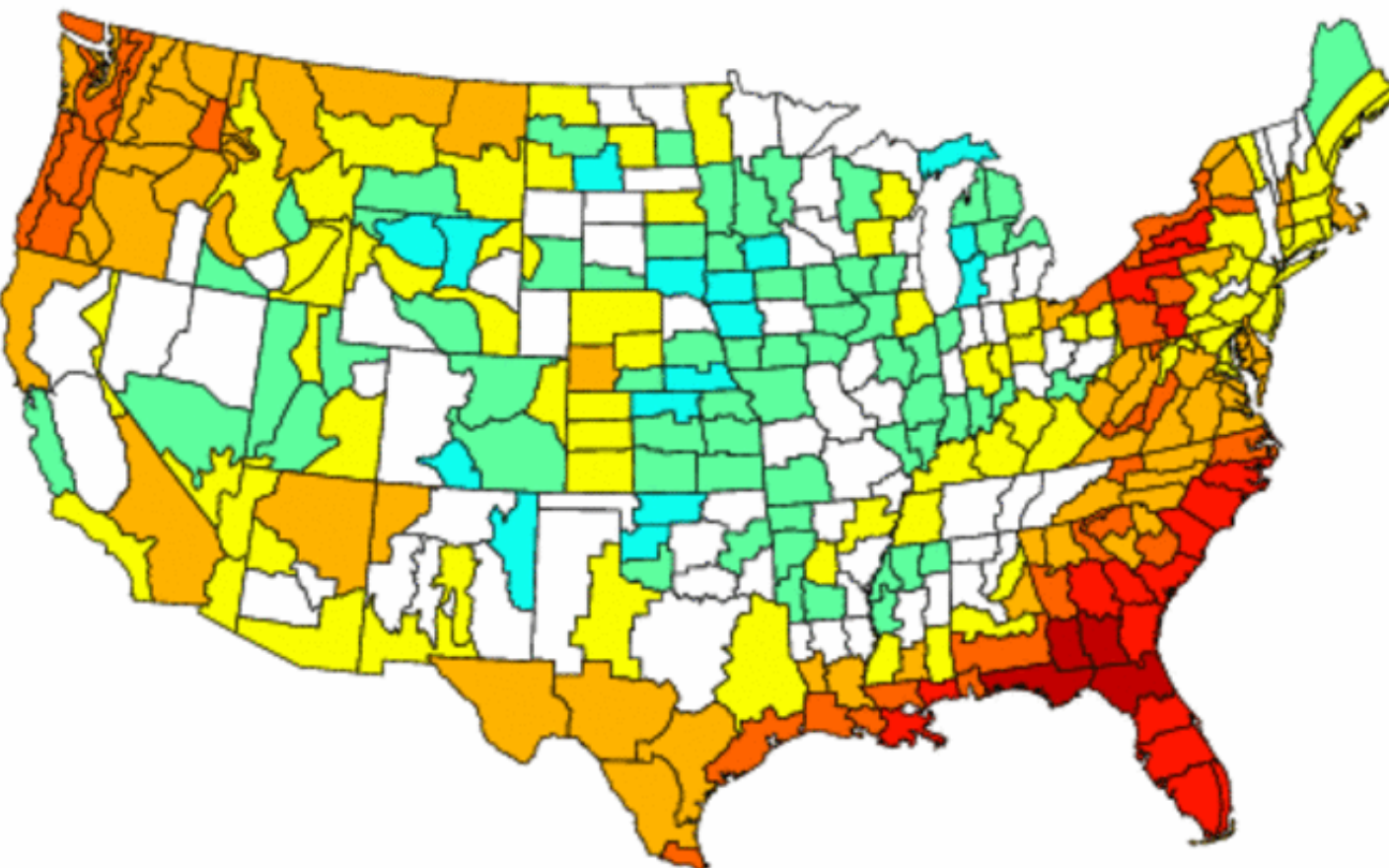


NOAA/ESRL PSD and CIRES-CDC

-0.90 -0.50 -0.10 0.30 0.70

A closer look at strong negative PDO/weak La Niña combination

Composite Standardized Precipitation Anomalies
Dec to Feb 1950–51, 1961–62, 1962–63, 1967–68, 1999–00, 2000–01
Versus 1950–1995 Longterm Average



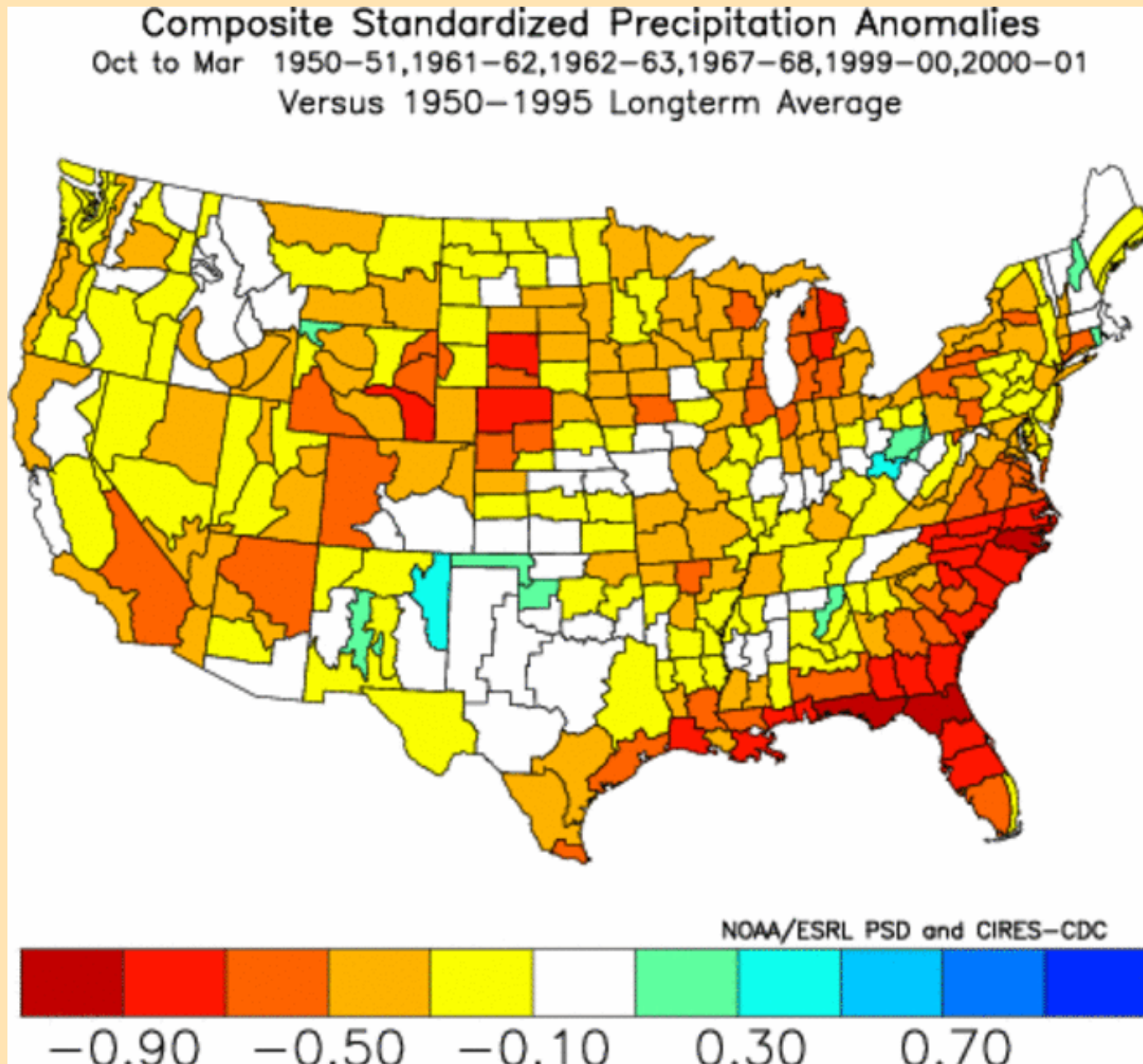
NOAA/ESRL PSD and CIRES–CDC

–0.90 –0.50 –0.10 0.30 0.70

Winter

Outcome: Not too many cases, they include sequential drought winters of 1961/2 and 62/3, but little ‘signal’ in central-northern California.

Another look at strong negative PDO/weak La Niña combination



Total Season:

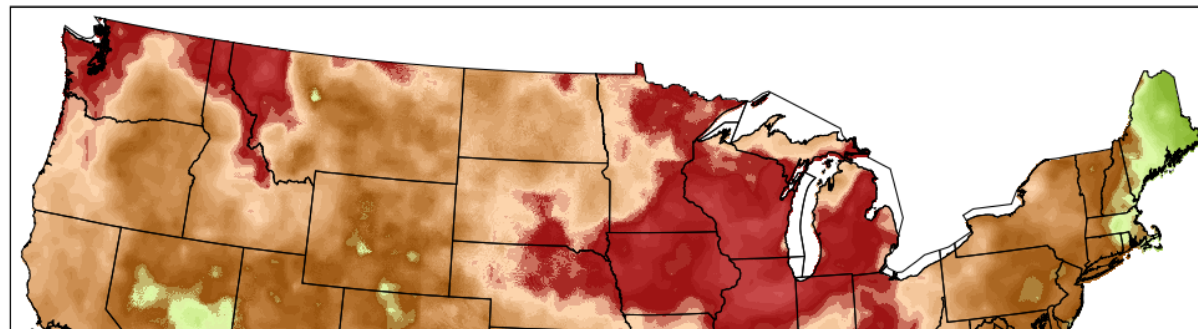
Depressing outcome for much of the U.S., including the Upper Colorado Basin! But this composite is based on fewer cases, so it is less reliable than 10-case composites.

What about the next two weeks?

Analog Prob Precip > 66th Percentile

fcst from 2008112000 valid 2008112500-2008113000

Percent



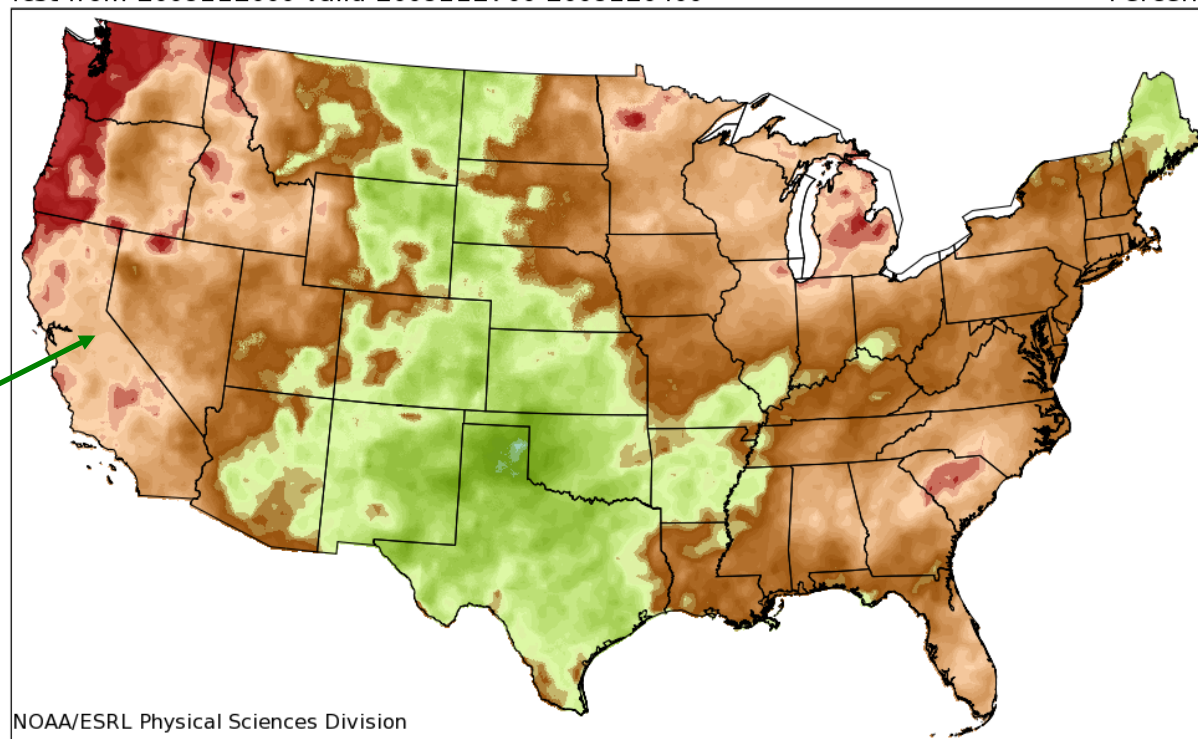
NOAA/ESRL Physical Sciences Division



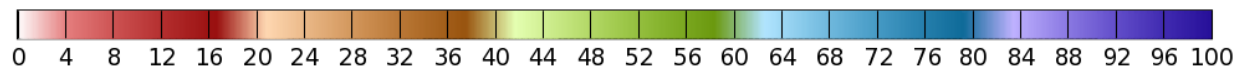
Analog Prob Precip > 66th Percentile

fcst from 2008112000 valid 2008112700-2008120400

Percent



NOAA/ESRL Physical Sciences Division



‘Reforecast’ from yesterday: Modest odds for rain in CA, but better odds for winter storm to the east (could combine with arctic air after Thxgiving!)

**‘Near-normal’
precipitation odds
for CA**

Executive Summary

- Next two weeks don't look as good as Halloween storm; models have had a hard time dealing with incoming storm - run-to-run changes from next to nothing in central CA vs. another 5-10" totals for next two weeks! Southern CA should get some much-needed moisture to lower fire danger.
- Current classification of weak La Niña/strong negative PDO does not make much difference for individual composites, leaving northern (southern) CA in near-normal (dry) territory.
- Various other factors leave us with similar scenarios, but updates with October data have added a slight drying trend to overall picture.
- While strong intraseasonal activity was not foreseen last winter, there is even less indication for this to happen this winter; the best case scenario: continued La Niña/negative PDO into early winter, followed by transition to El Niño in early spring; this would also favor more intraseasonal activity - odds for this are SMALL, but not zero.
- Plan for the worst/hope for the best, and watch for an update in six weeks!